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1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

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U. S. NAVAL AIR DEVELOPMENT CENTER

JOHNSVILLE, PENNSYLVANIA

Anti-Submarine Warfare Laboratory

REPORT NO. NADC-AW-6223

1 OCT 1962

VOLUME I

ATLAS OF INFRARED SEA BACKGROUND PATTERNS (U)
25 MARCH 1959 TO 28 MARCH 1962

PHASE REPORT

WEPTASK NO. RUDCLB000/2021/FO01-99-02

Problem No. 204

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Since the offset printing process used to produce this report, the infrared pictures shown herein have a reduced range of gray shades and reduced detail as compared to the original photographs. The original photographs and other data were available at the U.S. Navy Research Laboratory, Stennis Space Center, Mississippi.

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NADC-AW-6223

VOLUME I
ATLAS OF INFRARED SEA BACKGROUND PATTERNS (U)
25 MARCH 1959 TO 28 MARCH 1962

PHASE REPORT
WEPTASK NO. RUDCLB000/2021/FO01-99-02
Problem No. 204

- Ref: (a) BUAER CONF ltr Aer-AV-433 ser 001532 of 20 Sep 1956
(b) CONF Report No. NADC-AW-N5916, "Technical Note, Submarine Wake Detection Program," of 5 Jun 1959
(c) CONF Report No. NADC-AW-N5917, "Technical Note, Infrared Wake Detection," (C), of 8 Oct 1959
(d) CONF Report No. NADC-AW-L5932, "Phase Report, Submarine Wake Detection Flight Trials of the AN/AAR-9(XA-2)," (C), of 23 Feb 1960
(e) SECRET Report No. NADC-AW-L6005, "Phase Report, Submarine Wake Detection Flight Trials of the Reconofax Camera," (C), of 30 Mar 1960
(f) CONF Report No. NADC-AW-6218, "Flight Trials of the Infrared Antisubmarine Warfare Bomb Director Sight Unit," (C), (in printing)
(g) CONF Report No. NADC-AW-6233, "Submarine Wake Detection Flight Trials of the AN/AAR-13(XH-1)," (C), (in printing)
(h) WEPTASK No. RUDCLB000/2021/FO01-05-002, Problem Assignment No. 204 of 7 Sep 1961
(i) NAVAIRDEVGEN AW-411 SECRET/CONF Biweekly Progress Reports with encls for 16 Sep 1960 to 30 Apr 1961
(j) NAVAIRDEVGEN AW-411 SECRET/CONF Monthly Progress Reports for May 1961 to Jun 1962
(k) SECRET Report No. NADC-AW-N6207, "Technical Note, Airborne Infrared Oceanographic Mapping," (U), of 3 May 1962
(l) SECRET Report No. NADC-AW-N6208, "Technical Note, NAVAIRDEVGEN Airborne Infrared Developments," (U), of 8 Jun 1962

INTRODUCTION

Reference (a) requested the U. S. Naval Air Development Center (NAVAIRDEVGEN) develop techniques for detecting wakes of submerged submarines by use of small, lightweight, infrared equipments designed for installation in heavier-than-air craft. Reference (b) enumerates and classifies wake phenomena from a theoretical point of view. Reference (c) outlines the NAVAIRDEVGEN experimental infrared wake detection program and gives preliminary results.

As part of the experimental program, six thermal mapping devices were investigated. Final results of investigations of the AN/AAS-4(XA-2), the

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AN/AAR-9(XA-2), the Reconofax Camera, the Infrared Antisubmarine Warfare Bomb Director Sight Unit, and the AN/AAR-13(XH-1) are given in references (c), (d), (e), (f), and (g).

Reference (h) superseded reference (a) and requested the NAVAIRDEVCECEN conduct studies, establish equipment characteristics, procure equipment, and perform technical and flight evaluations of modified line-scan passive infrared surveillance systems for submerged submarine wake detection. References (i) and (j) outline the current program and give preliminary results obtained with the unmodified and modified AN/AAD-2 infrared detecting sets.

References (k) and (l), which include infrared pictures recorded by the AN/AAR-9, the Reconofax Camera, and the AN/AAD-2, propose a variety of maritime applications for infrared devices. Reference (l) describes the AN/AAD-2 and some of the modifications to which it has been subjected.

Figure 1 illustrates schematically the operation of the AN/AAD-2, which recorded the majority of pictures in this atlas.

The atlas describes pictorially the ocean surface as recorded by several infrared mapping devices using a variety of infrared detecting elements during the three-year period beginning 25 March 1959. These pictures were recorded under a variety of conditions of haze, cloud cover, air and water temperatures, water depths, aircraft altitudes, latitudes, longitudes, times, and seasons.

All the pictures recorded by the AN/AAD-2 installed in the NAVAIRDEVCECEN P2V-5F aircraft, BuNo 131403, and reproduced in this atlas are "mirror image" prints. The two parallel dark lines running longitudinally on the pictures recorded by the AN/AAD-2 are to be ignored; these lines are caused by crimping of the recording film in the compact AN/AAD-2 film magazine. Dark portions of the thermal pictures in this atlas correspond to effectively cooler areas; light portions represent effectively warmer areas.

The title arrangement for each thermal picture in the atlas is as follows: Figure Number - ... Title ... (Time; Aircraft Altitude; Latitude; Longitude; Dimensions of Area Shown; Water Depth in Area Shown). A complete index of the figures is given in the back of the report.

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Reported by:

(b) (6)
F. M. Moser and
Special Methods Division

Approved by:

(b) (6)
Superintendent
Special Methods Division

(b) (6)
Technical Director

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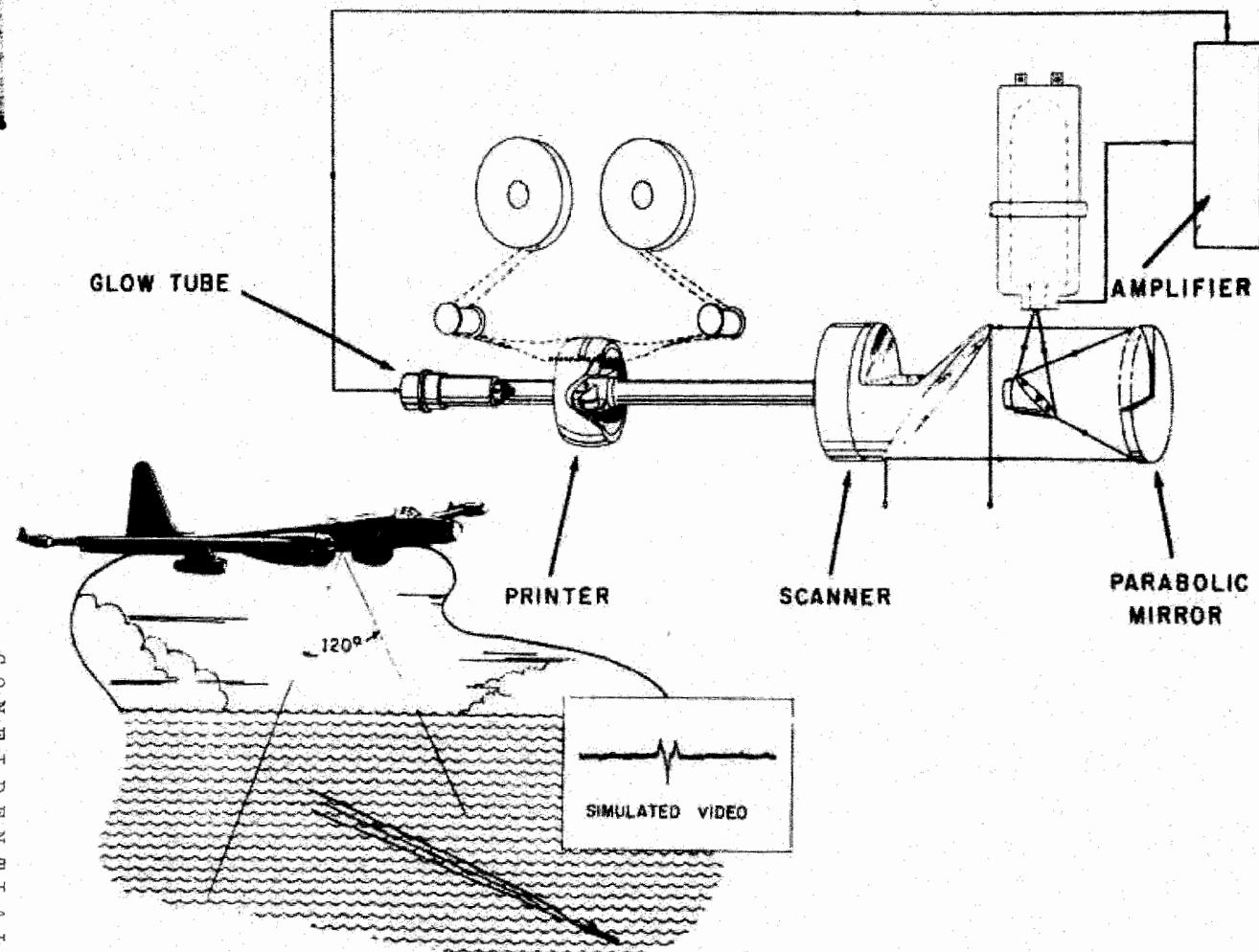


FIGURE 1 - Schematic of AN/AAD-2 Operation

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(b)(1) per E.O. 13526 Section 3.3(b)(4)

This thermal picture was recorded by the Reconofax
Camera installed in HRB-Singer, Inc, Cessna 310-B
aircraft

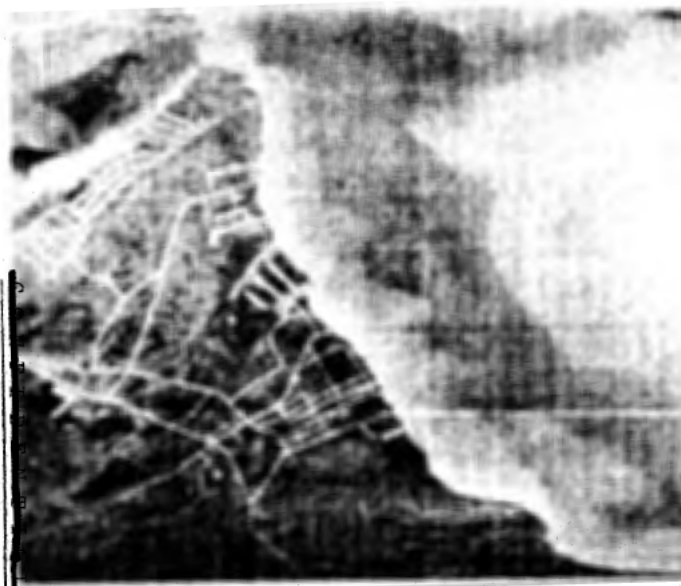
Date: 20 May 1959

Phase of Moon: full on 22 May

Detector: 3.2 mm² (circular) p-type Ge:Au
(Syracuse University)

NOTE: Compare thermal picture with portion
of U. S. Coast and Geodetic Survey
Chart 12/6 reproduced below:

(Soundings are in feet)



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FIGURE 3 - Shoal Water in the Vicinity of Waretown, New Jersey (2200 R; 5000 ft; 39°47'N; 71°10'W;
4 by 4.5 nmi; 0-1.5 fathoms)

This thermal picture was recorded by the AN/AAD-2
installed in the HRB-Singer, Inc, Cessna 310-B aircraft
Date: 14 February 1961
Sunset: 1736 R; Moonset: 1700 R
Air Temperature (1500 ft): 0°C
Cloud Cover: no clouds
Visibility: hazy
Detector: 3 mm² (circular) p-type Ge: Au
(Syracuse University)



FIGURE 4 - Surfaced Submarine, Wake, and Natural Sea Surface Patterns (1900 R; 1300 ft; 39°52'N;
71°29'W; 0.8 by 1.8 nmi; 193-465 fathoms)

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This thermal picture was recorded by the AN/AAD-2
installed in the HRB-Singer, Inc, Cessna 310-B aircraft
Date: 27 February 1961
Sunset: 1750 R; Moonrise: 1459 R
Air Temperature (1600 ft): 10°C
Cloud Cover: no clouds
Visibility: hazy
Detector: 3 mm² (circular) p-type Ge: Au (Syracuse University)

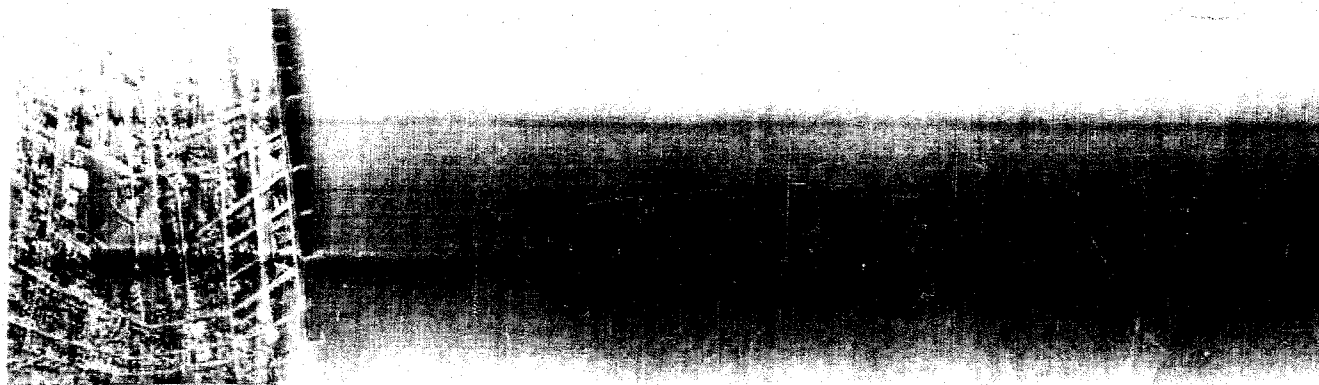


FIGURE 5 - Shoreline and Natural Sea Surface Patterns (1730 R; 1600 ft; 40°17'N; 74°02'W;
0.9 by 2.6 nmi; 0-8 fathoms)

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This thermal picture was recorded by the AN/AAR-13(XH-1)
installed in the NAVAIRDEVGEN P2V-5F aircraft BuNo 131403
Date: 27 February 1961
Detectors: 60 thermistor bolometers

NOTE: Compare this picture with figure 5 of the same area
recorded at the same time by the AN/AAD-2.

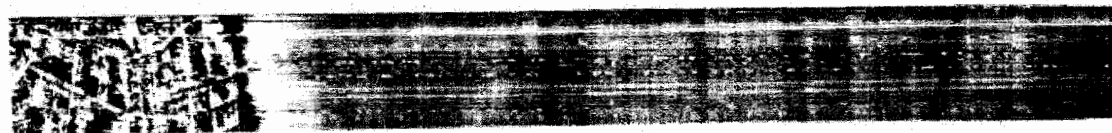


FIGURE 6 - Shoreline and Natural Sea Surface Patterns (1730 R; 1800 ft; 40°17'N; 74°02'W;
0.5 by 2.6 nmi; 0-8 fathoms)

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This thermal picture was recorded by the AN/AAD-2
installed in the HRB-Singer, Inc Cessna 310-B aircraft
Date: 3 April 1961
Sunset: 1827 R; Moonrise: 2105 R
Air Temperature (surface): 6°C
Cloud Cover: broken - bottoms at 4000 ft
Visibility: 4-6 miles (hazy)
Detector: 3 mm² (circular) p-type Ge: Au (Syracuse University)

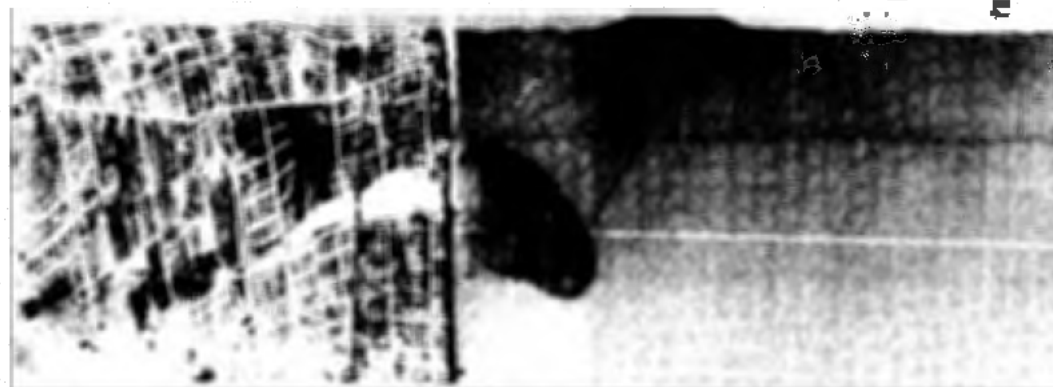


FIGURE 7 - Overflow of water from Takanassee Lake Reservoir (2306 R; 2200 ft; 40°17'N; 74°00'W;
1.3 by 2.3 nmi; 0-8 fathoms)

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This thermal picture was recorded by the AN/AAD-2
installed in the NAVAIRDEVCON F2V-5F aircraft
BuNo 131403
Date: 5 October 1961
Sunset: 1735 R; Moonset: 1545 R
Air Temperature (surface): 15°C
Cloud Cover: scattered high-altitude clouds
Visibility: 10 miles, hazy
Detector: 2.5 by 2.5 mm InSb (Philco)



FIGURE 8 - Tributaries of Shrewsbury River, Shoreline and Natural Water Surface Patterns (1754 R;
2000 ft; 40°19'N; 74°00'W; 1.2 by 3.3 nmi; 0-4 fathoms)

This thermal picture was recorded by the AN/AAD-2
installed in the NAVAIRDEVGEN P2V-5F aircraft
BuNo 131403
Date: 10 October 1961
Sunset: 1730 R; Moonset: 1814 R
Air Temperature (surface): 20°C
Cloud Cover: scattered high-altitude clouds
Visibility: 7-10 miles
Detector: 2.5 by 2.5 mm InSb (Philco)

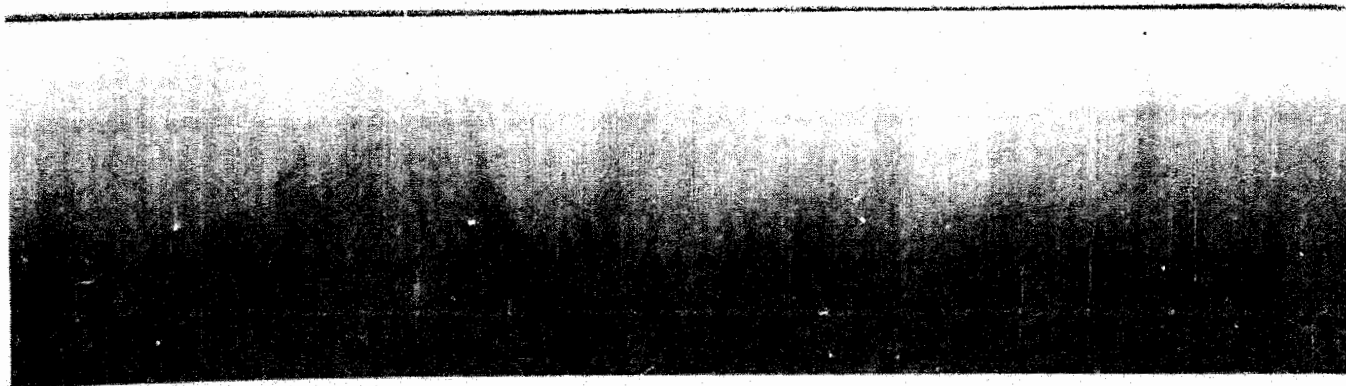


FIGURE 9 - Natural Sea Surface Patterns (2216 R; 3500 ft; 40°15'N; 73°00'W; 2.0 by 6.3 nmi; 20-25 fathoms)

This series of 3 thermal pictures was recorded by the
AN/AAD-2 installed in the NAVAIRDEVGEN P2V-5F aircraft
BuNo 131403
Date: 17 October 1961
Sunset: 1719 R; Moonset: 2348 R
Air Temperature (2500 ft): 16°C
Cloud Cover: no clouds
Visibility: 6-8 miles
Detector: 2.5 by 2.5 mm InSb (Philco)

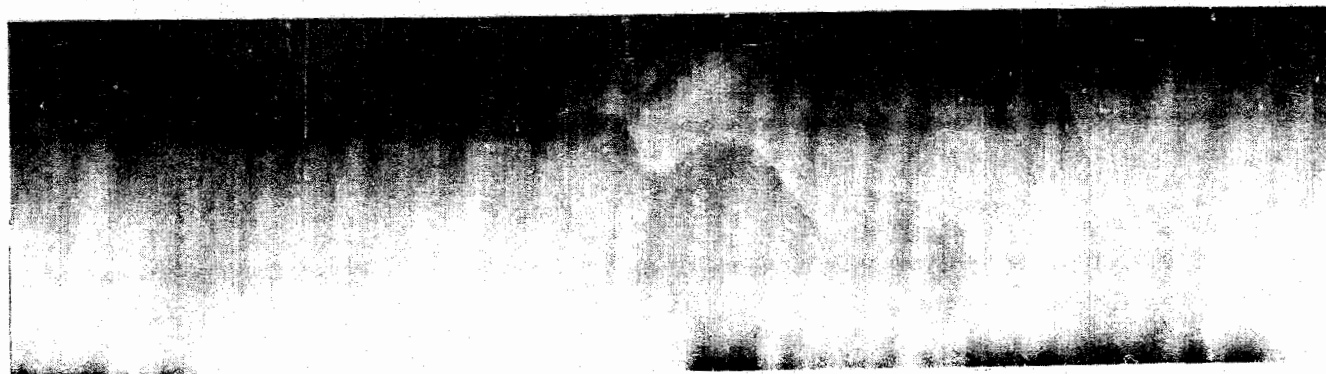


FIGURE 10-1 - Natural Sea Surface Patterns (1950 R; 2500 ft; 40°00'N; 72°00'W; 1.5 by 5.5 nmi;
40-75 fathoms)

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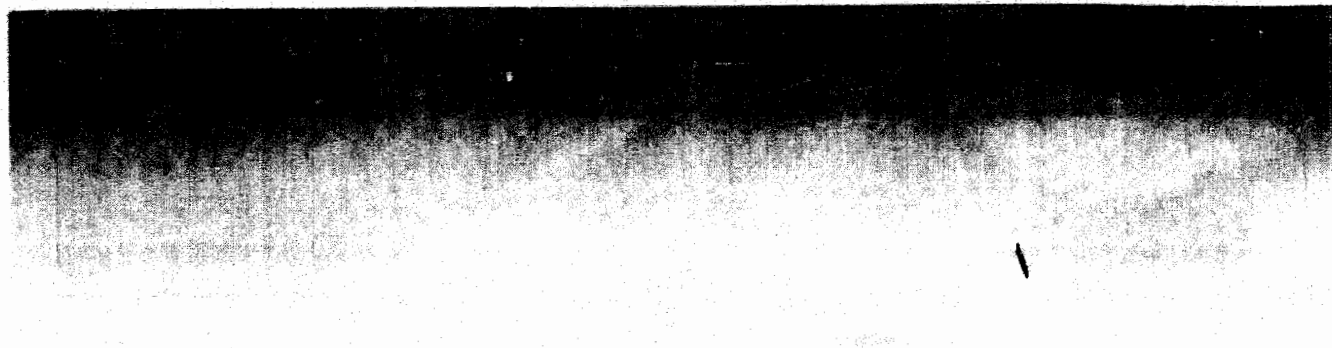


FIGURE 10-2 - Blimp and Natural Sea Surface Patterns (2053 R; 2500 ft; 40°00'N; 72°00'W; 1.5 by 3.5 nmi; 40-75 fathoms)

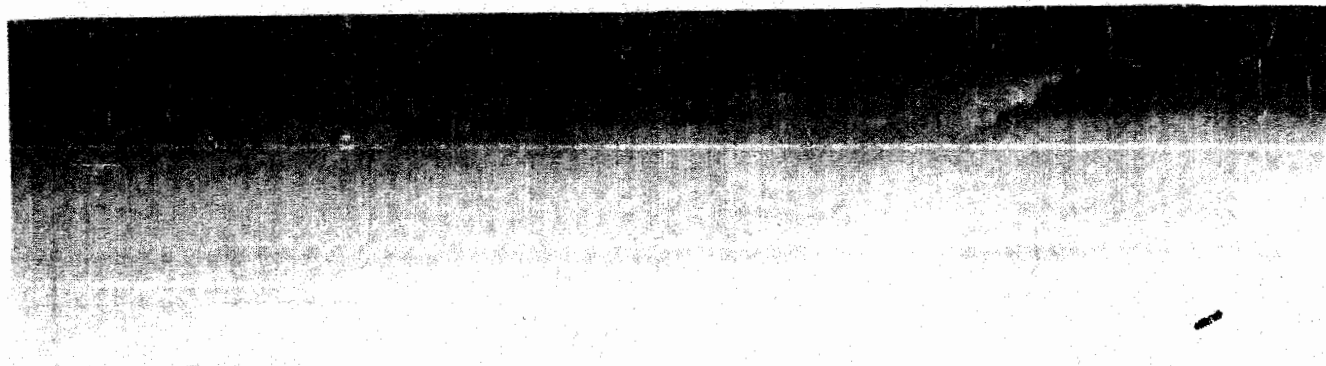


FIGURE 10-3 - Blimp and Natural Sea Surface Patterns (2107 R; 2500 ft; 40°00'N; 72°00'W; 1.5 by 3.5 nmi; 40-75 fathoms)

This series of 15 thermal pictures was recorded by the
AN/AAD-2 installed in the NAVAIRDEVGEN P2V-5F aircraft
BuNo 131403
Date: 8 November 1961
Sunset: 1650 R; Moonset: 1722 R
Air Temperature (2500 ft): 8°C
Cloud Cover: scattered - bottoms at 2500 ft
Visibility: unlimited
Detector: 2.5 by 2.5 mm InSb (Philco)

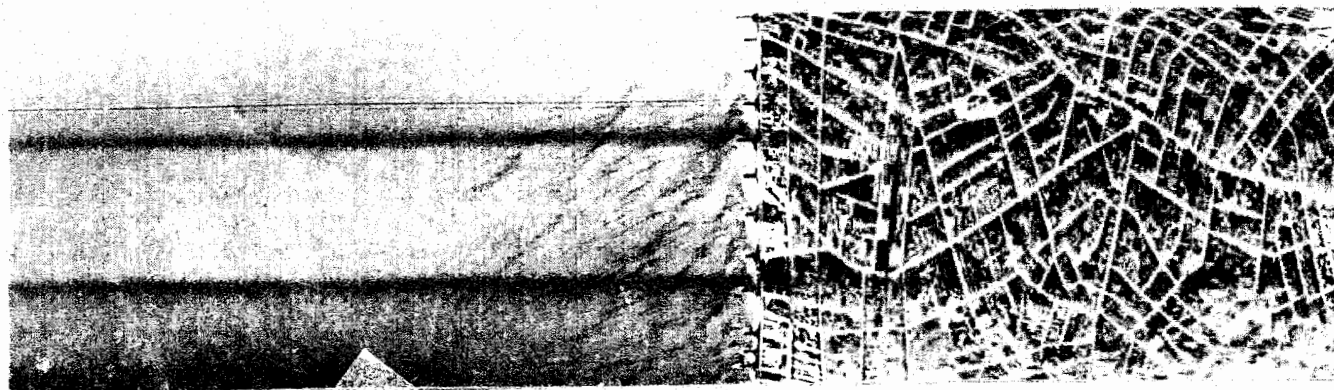


FIGURE 11-1 - Shoreline and Natural Sea Surface Patterns (1923 R; 2100 ft; 40°17'N; 74°02'W;
1.2 by 3.5 nmi; 0-8 fathoms)

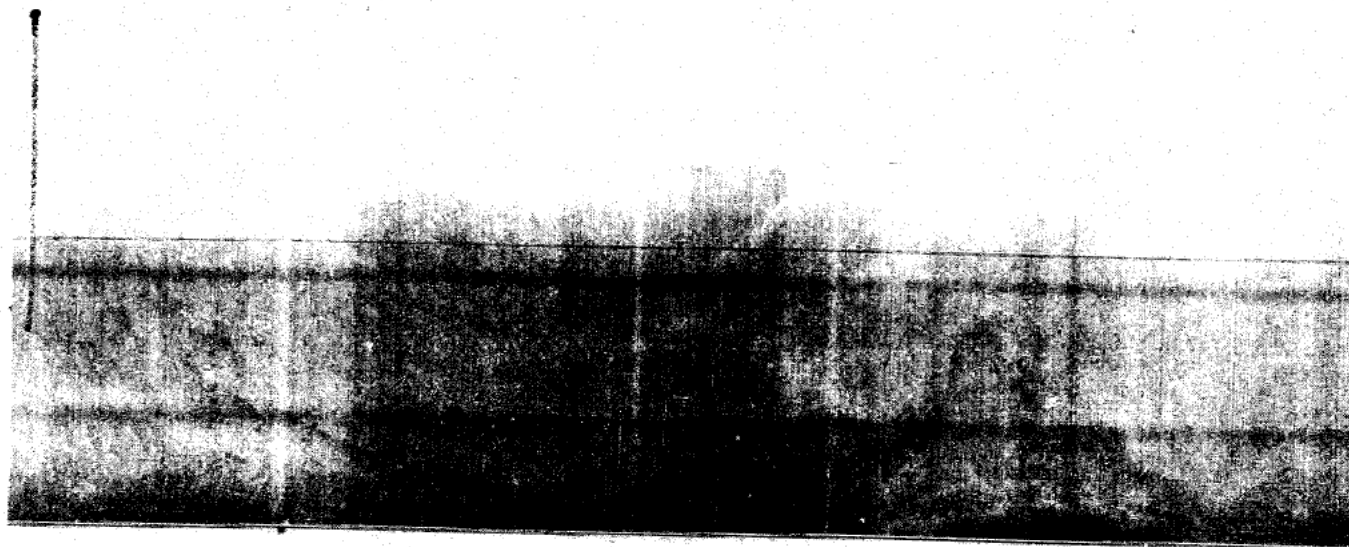


FIGURE 11-2 - Natural Sea Surface Patterns, Smoke Light in Water, and Airship (2126 R; 2500 ft; 39°55'N; 72°05'W; 1.5 by 4.5 nmi; 34-70 fathoms)

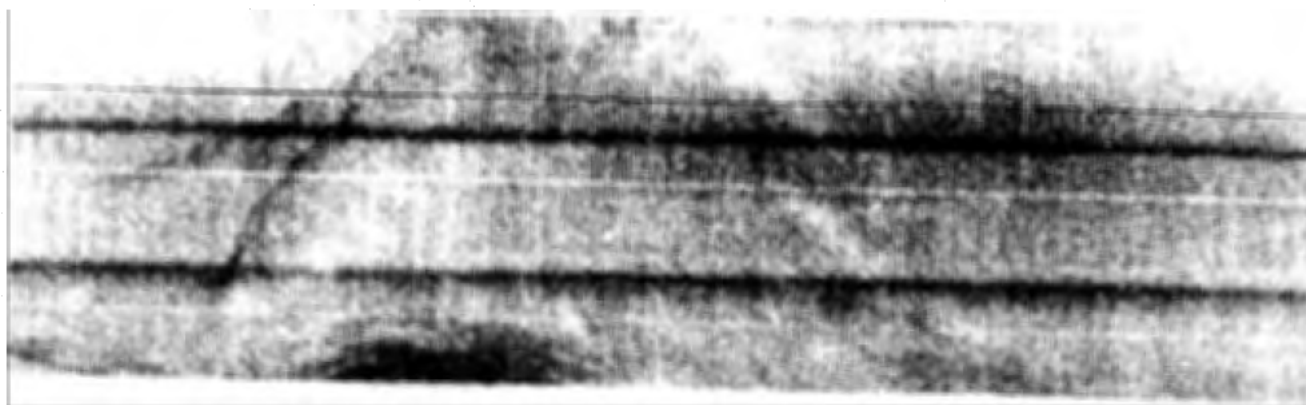


FIGURE 11-3 - Natural Sea Surface Patterns and Smoke Light in Water (2148 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.7 nmi; 34-70 fathoms)

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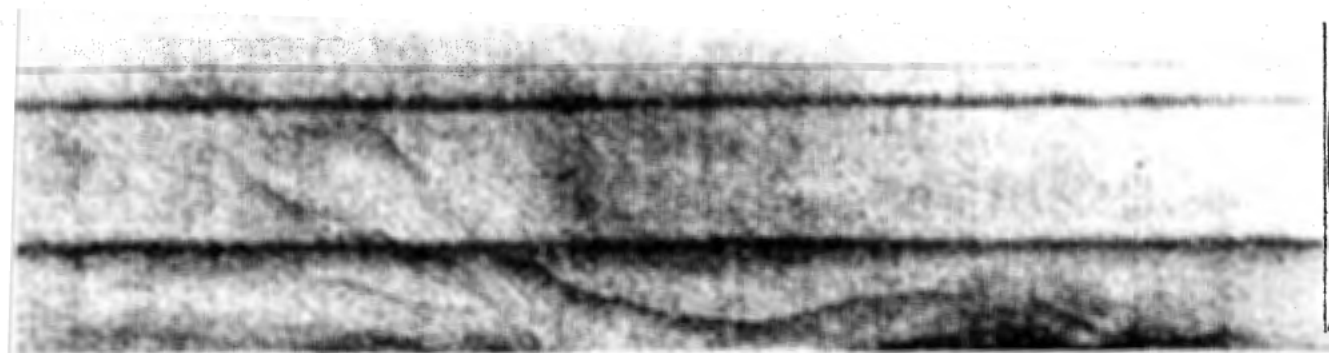


FIGURE 11-4 - Natural Sea Surface Patterns (2149 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.7 nmi; 34-70 fathoms)

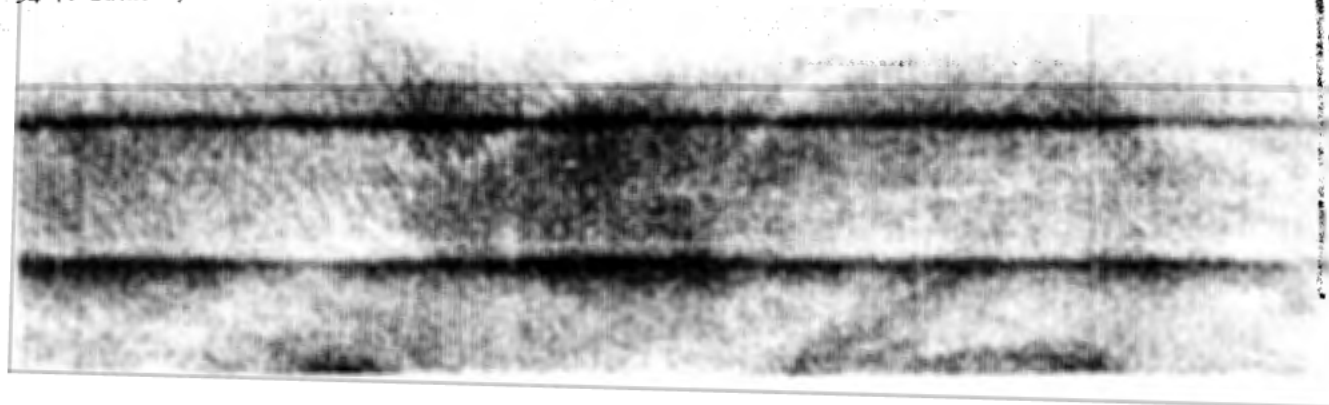


FIGURE 11-5 - Natural Sea Surface Patterns and Smoke Light in Water (2156 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.7 nmi; 34-70 fathoms)

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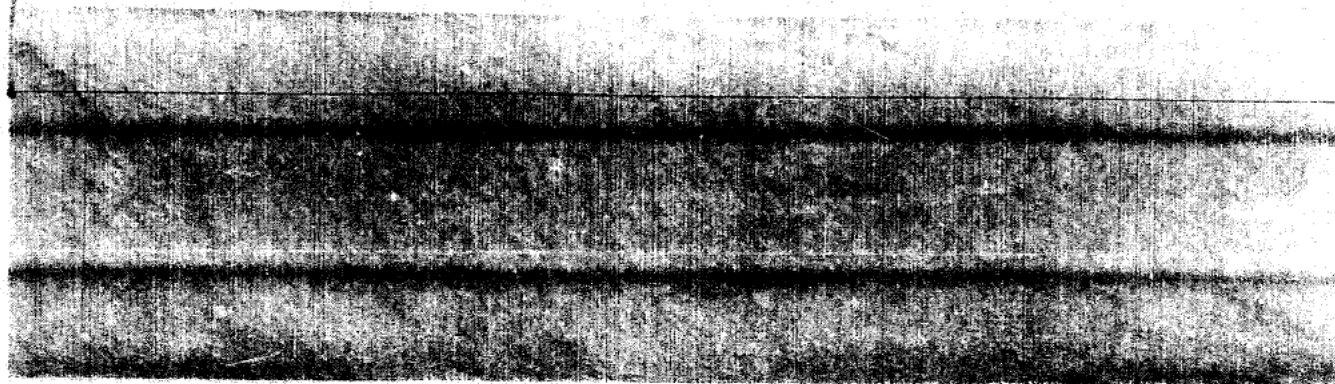


FIGURE 11-6 - Natural Sea Surface Patterns (2157 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.7 nmi;
34-70 fathoms)

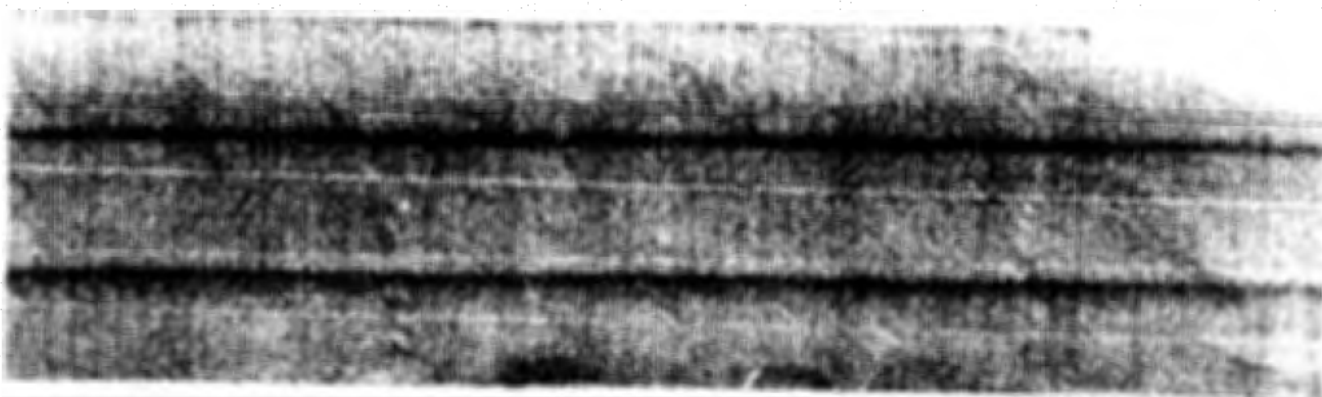


FIGURE 11-7 - Natural Sea Surface Patterns (2206 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.8 nmi;
34-70 fathoms)

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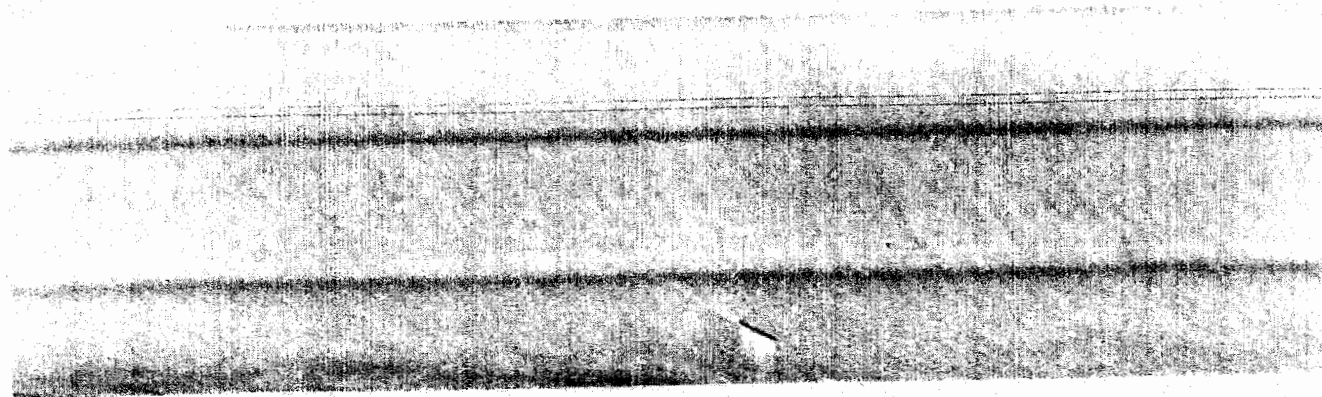


FIGURE 11-8 - Ship, Wake, and Natural Sea Surface Patterns (2207 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.8 nmi; 34-70 fathoms)

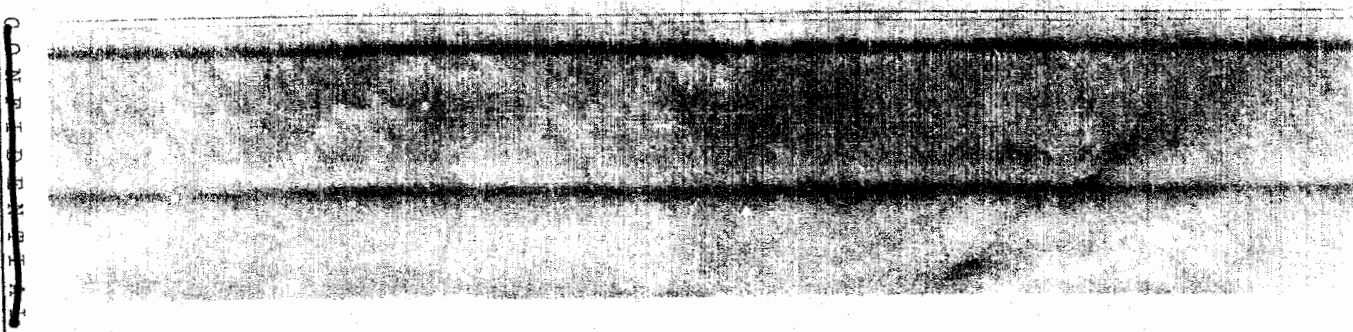


FIGURE 11-9 - Natural Sea Surface Patterns (2215 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.7 nmi; 34-70 fathoms)

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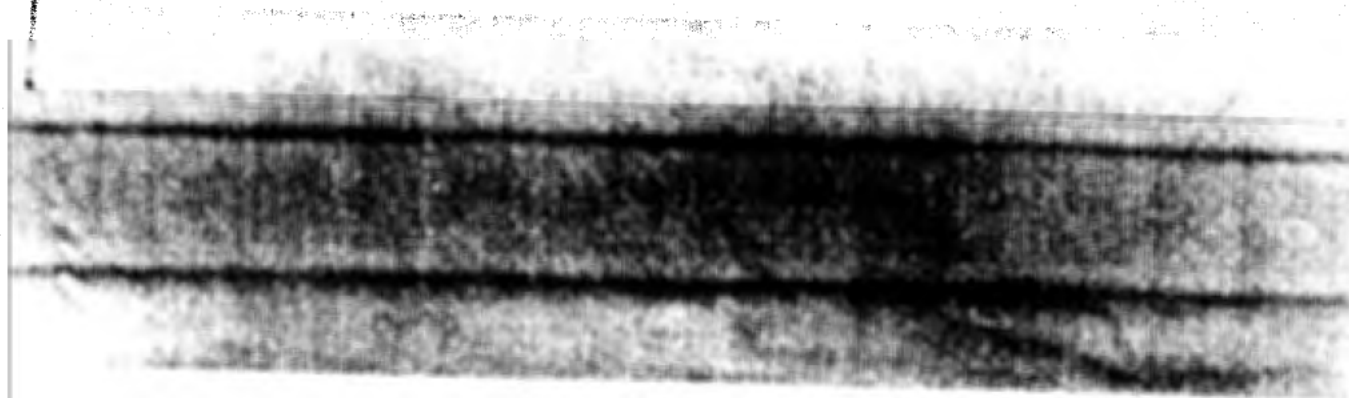


FIGURE 11-10 - Natural Sea Surface Patterns (2216 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.7 nmi; 34-70 fathoms)

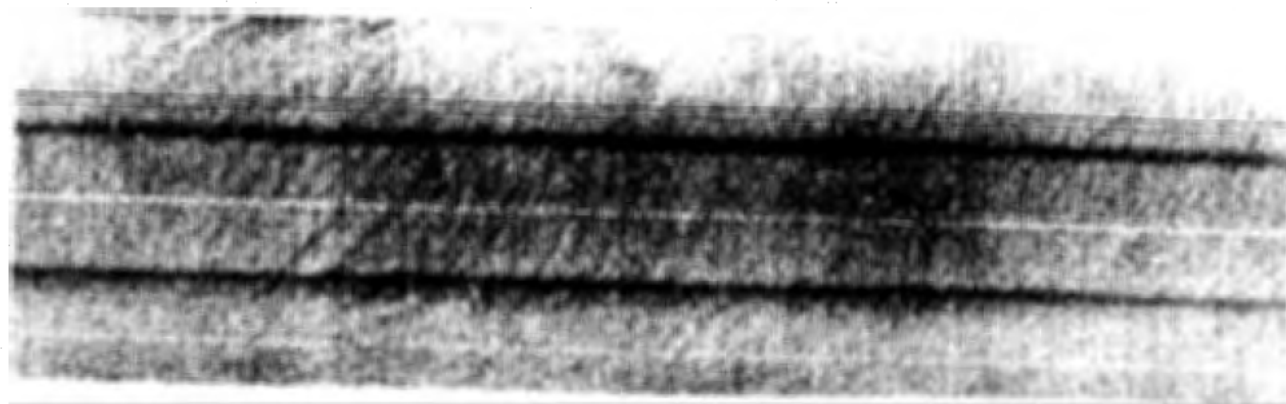


FIGURE 11-11 - Natural Sea Surface Patterns (2230 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.7 nmi; 34-70 fathoms)

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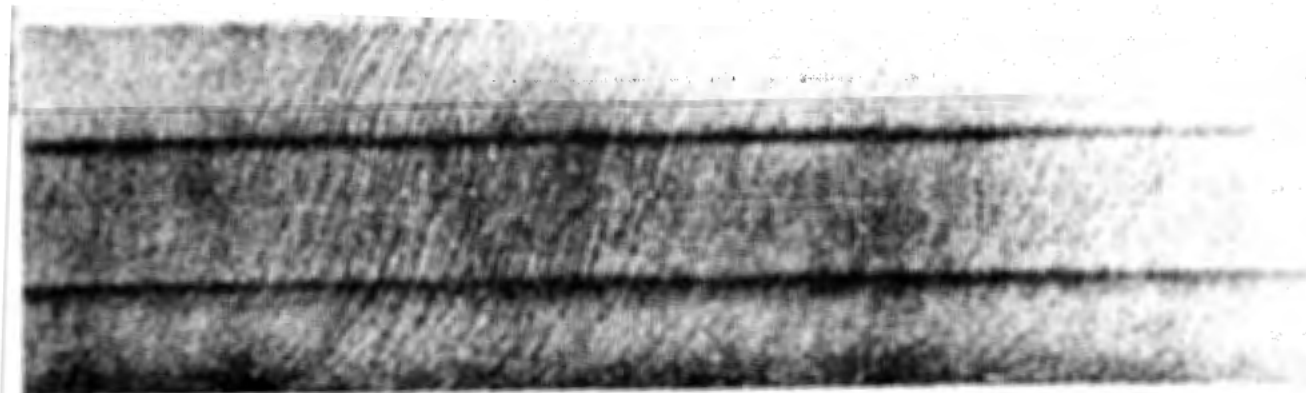


FIGURE 11-12 - Natural Sea Surface Patterns (2231 R; 1000 ft; 39°55'N; 72°05'W; 0.6 by 1.7 nmi; 34-70 fathoms)

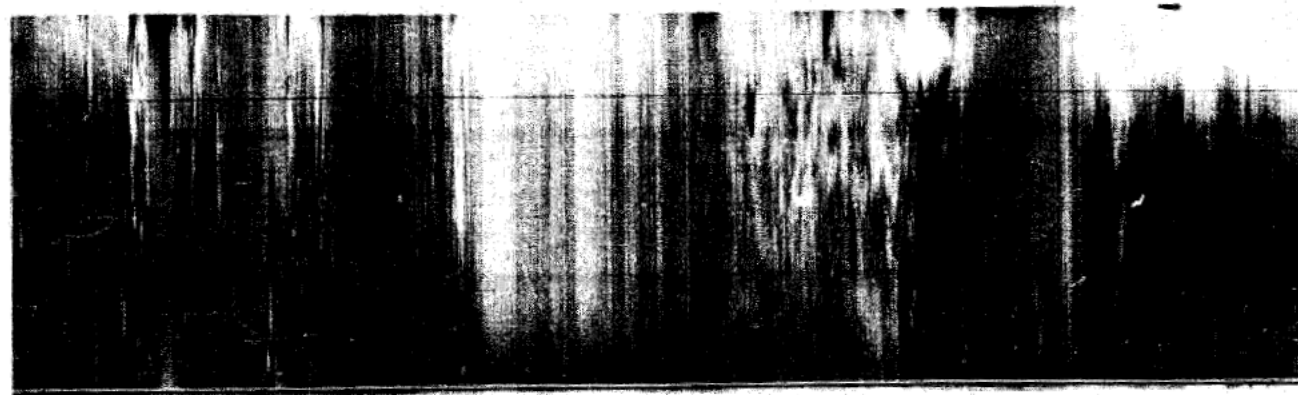


FIGURE 11-13 - Clouds (aircraft is flying in and over clouds) (2255-58 R; 3000 ft; 40°00'N; 72°10'W; 1.7 by 10 nmi)

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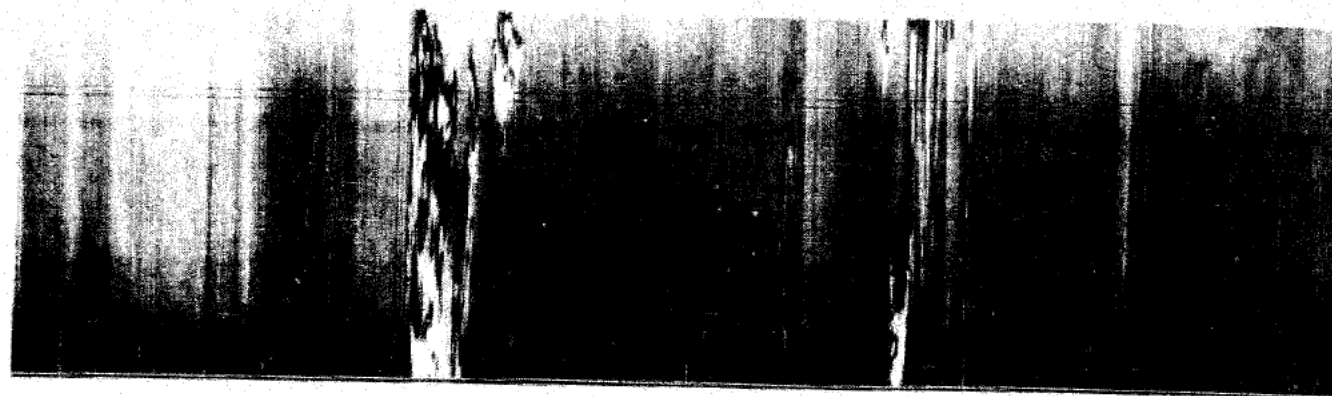


FIGURE 11-14 - Clouds (distorted transversely due to proximity to optical system) (2301-4 R; 4500 ft; 40°05'N; 72°20'W; 2.6 by 9 nmi)

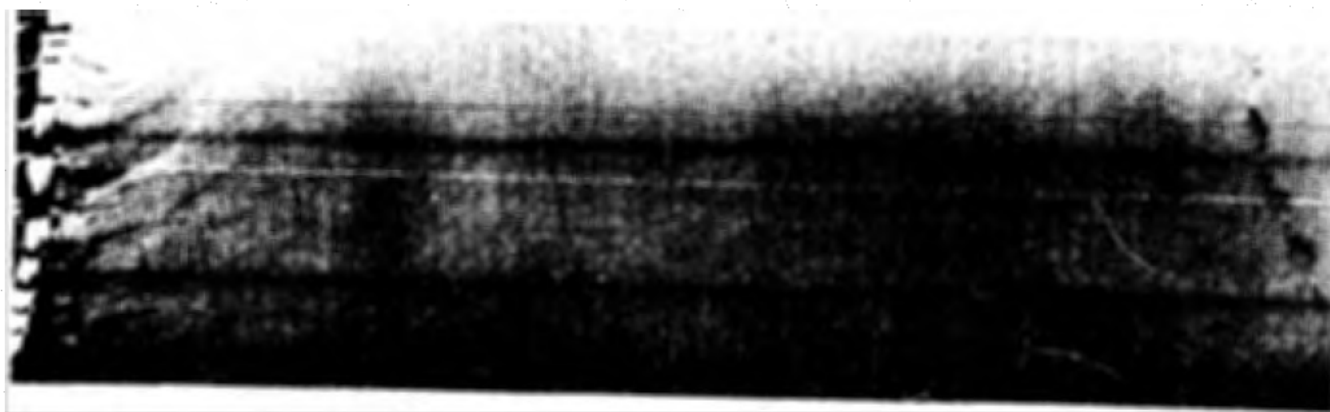


FIGURE 11-15 - Shoreline and Natural Sea Surface Patterns (2330 R; 2000 ft; 40°17'N; 74°02'W; 1.2 by 2.8 nmi; 0-8 fathoms)

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This series of 3 thermal pictures was recorded by the
AN/AAD-2 installed in the NAVAIRDEVCON P2V-5F BuNo 131403
Date: 15 November 1961
Sunset: 1644 R; Moonset: 2355 R
Air Temperature (surface): 12°C
Cloud Cover: no clouds
Visibility: 3-7 miles, hazy
Detector: 2.5 by 2.5 mm InSb (Philco)



FIGURE 12-1 - Chesapeake Bay Bridge and Natural Water Surface Patterns (1908 R; 1000 ft; 38°59'N;
76°23'W; 0.6 by 1.7 nmi; 5-10 fathoms)

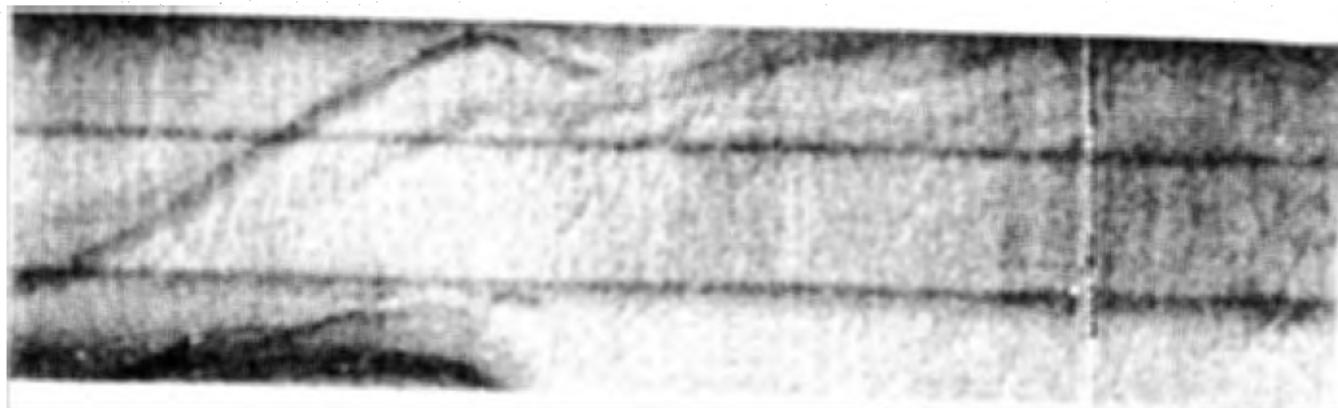


FIGURE 12-2 - Chesapeake Bay Bridge and Natural Water Surface Patterns (1918 R; 1000 ft; 38°59'N; 76°23'W; 0.6 by 1.8 nmi; 5-10 fathoms)

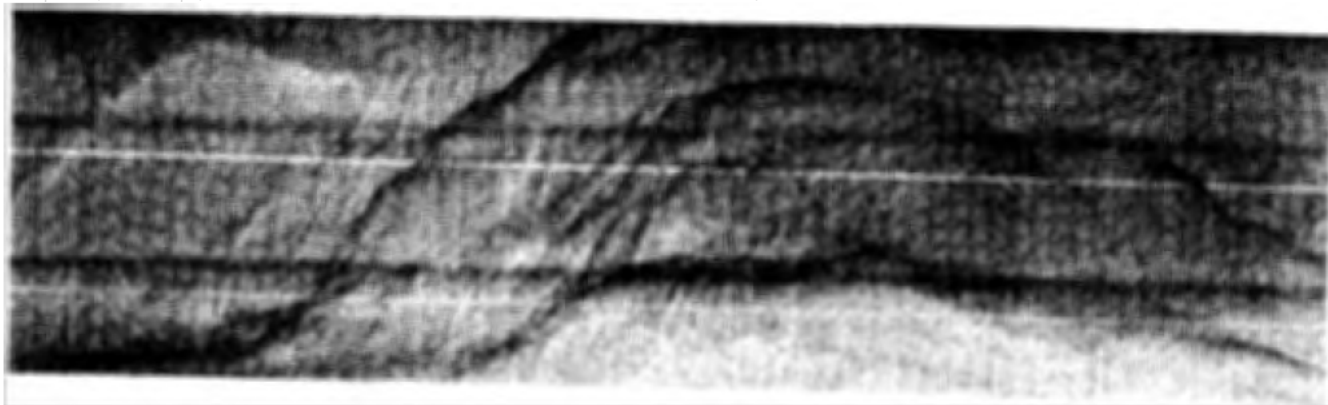


FIGURE 12-3 - Natural Water Surface Patterns in Chesapeake Bay (1949 R; 1100 ft; 38°58'N; 76°23'W; 0.6 by 1.8 nmi; 5-10 fathoms)

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This series of 10 thermal pictures was recorded by the
AN/AAD-2 installed in the NAVAIRDEVCOM P2V-5F BuNo 131403
Date: 21 November 1961
Sunset: 1639 R; Moonrise: 1633 R
Detector: 2.5 μ , 2.5 mm InSb (Philco)

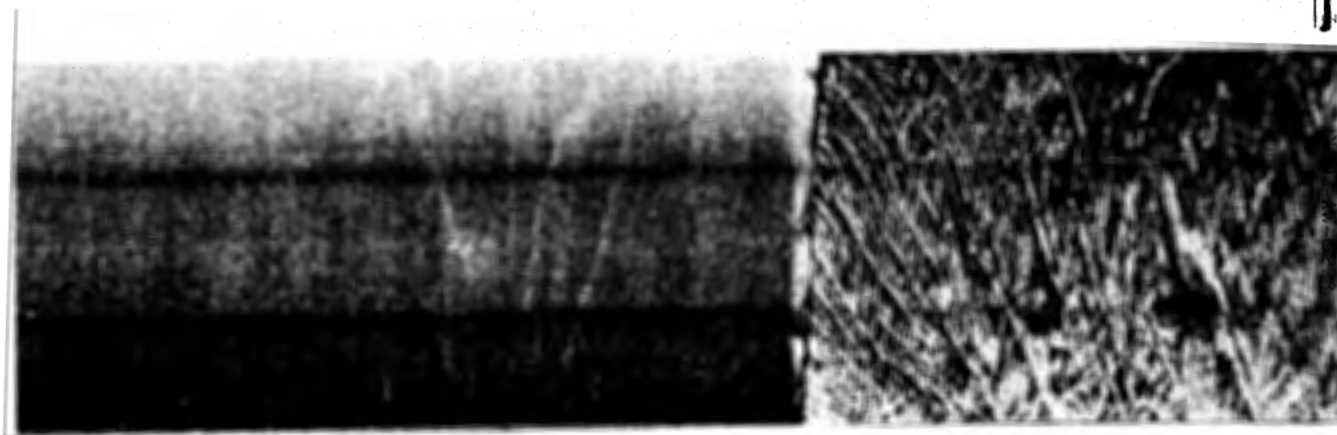


FIGURE 13-1 - Shoreline and Natural Sea Surface Patterns (1820 R; 2000 ft; $40^{\circ}15'N$; $74^{\circ}00'W$;
1.2 by 9.9 nmi; 0-15 fathoms)

NOTE: Longitudinal compression is due to an incorrect (slow) film speed.

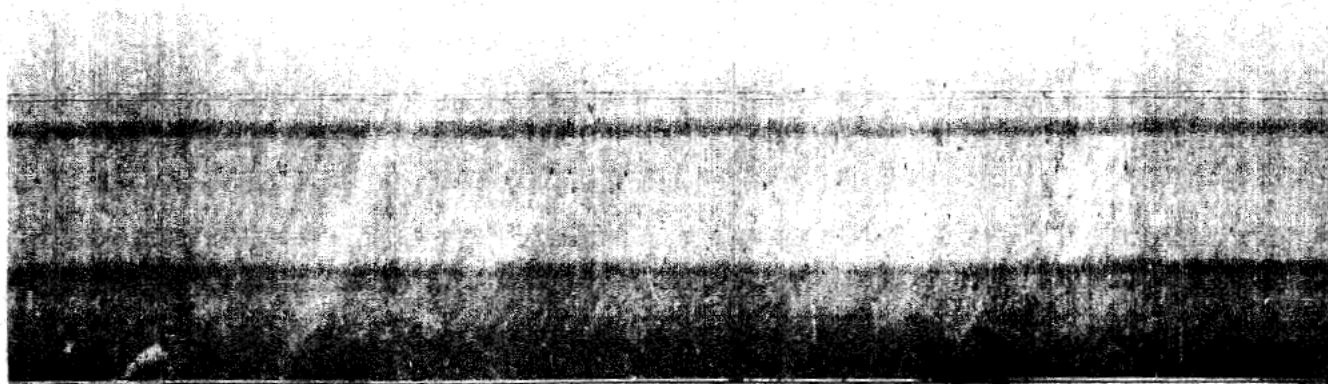


FIGURE 13-2 - Whitecaps and Other Natural Sea Surface Patterns (1834 R; 2000 ft; 39°58'N; 73°15'W; 1.2 by 9.9 nmi; 26-42 fathoms)



FIGURE 13-3 - Whitecaps and Other Natural Sea Surface Patterns (1846 R; 2000 ft; 39°44'N; 72°37'W; 1.2 by 9.9 nmi; 28-42 fathoms)

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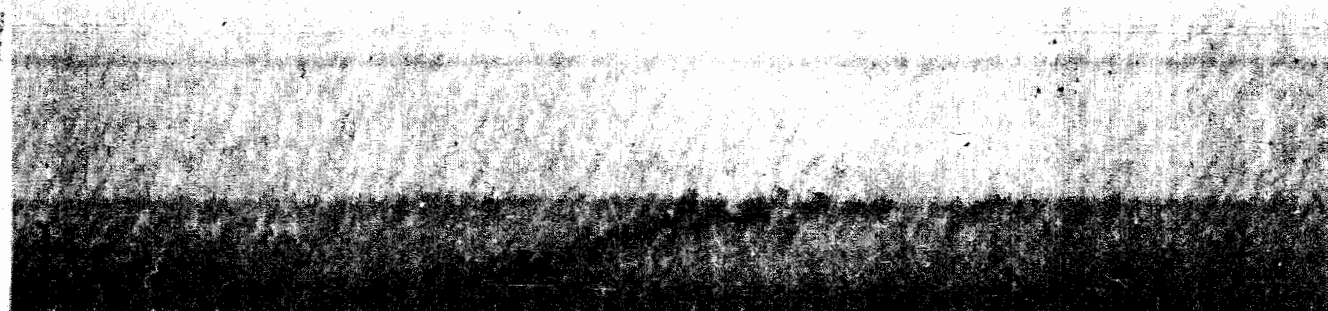


FIGURE 13-4 - Whitecaps and Other Natural Sea Surface Patterns (1931 R; 2000 ft; 39°20'N; 71°55'W; 1.2 by 8.7 nmi; 485-1164 fathoms)

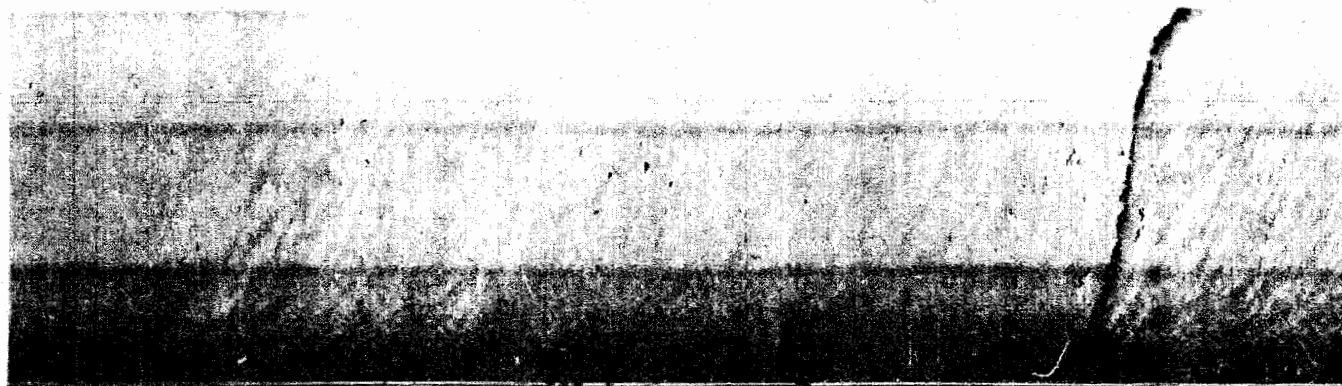


FIGURE 13-5 - Whitecaps and Other Natural Sea Surface Patterns (1935 R; 2000 ft; 39°20'N; 71°55'W; 1.2 by 8.7 nmi; 485-1164 fathoms)

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FIGURE 13-6 - Whitecaps and Other Natural Sea Surface Patterns (1943 R; 2000 ft; 39°20'N; 71°55'W; 1.2 by 7.3 nmi; 485-1164 fathoms)



FIGURE 13-7 - Whitecaps and Other Natural Sea Surface Patterns (2004 R; 2000 ft; 39°35'N; 72°13'W; 1.2 by 8.7 nmi; 63-77 fathoms)

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FIGURE 13-8 - Whitecaps and Other Natural Sea Surface Patterns (2021 R; 2000 ft; 39°56'N; 73°10'W; 1.2 by 3.1 nmi; 34-42 fathoms)

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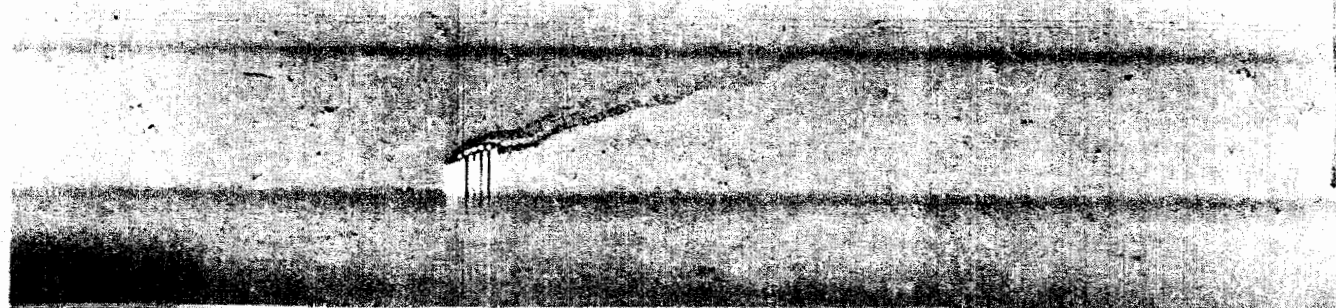
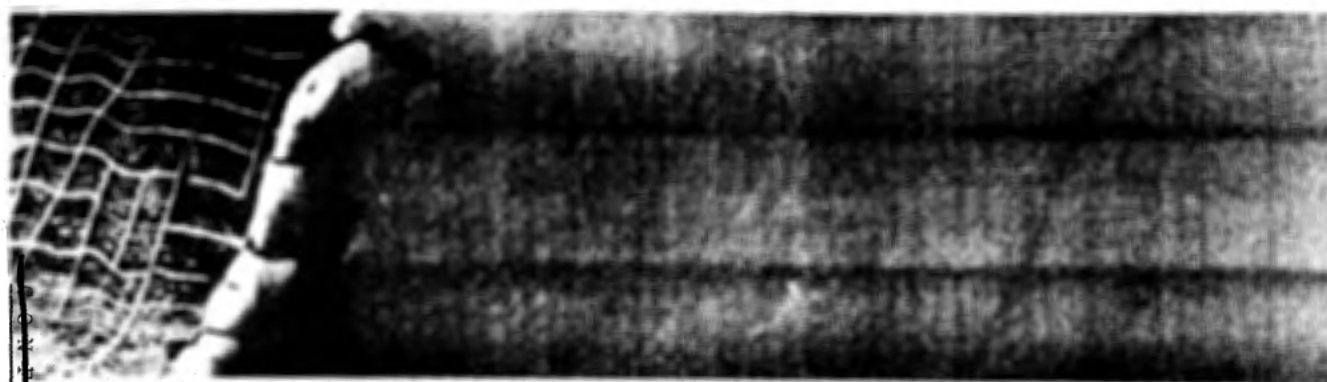


FIGURE 13-9 - Ship, Wake, and Whitecaps (2026 R; 2000 ft; 40°04'N; 73°29'W; 1.2 by 3.5 nmi; 19-46 fathoms)

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FIGURE 13-10 - Shoreline and Natural Sea Surface Patterns (2035 R; 2000 ft; 40°15'N; 74°00'W;
1.2 by 3.3 nmi; 0-15 fathoms)

This series of 10 thermal pictures was recorded by the
AN/AAD-2 installed in the NAVAIRDEVCEP P2V-5F aircraft
BuNo 131403
Date: 28 November 1961
Sunset: 1636 R; Moonrise: 2226 R
Cloud Cover: no clouds
Detector: 2.5 by 2.5 mm InSb (Philco)



FIGURE 14-1 - Natural Sea Surface Patterns (1746 R; 2000 ft; 40°30'N; 73°45'W; 1.2 by 3.3 nmi;
11-13 fathoms)

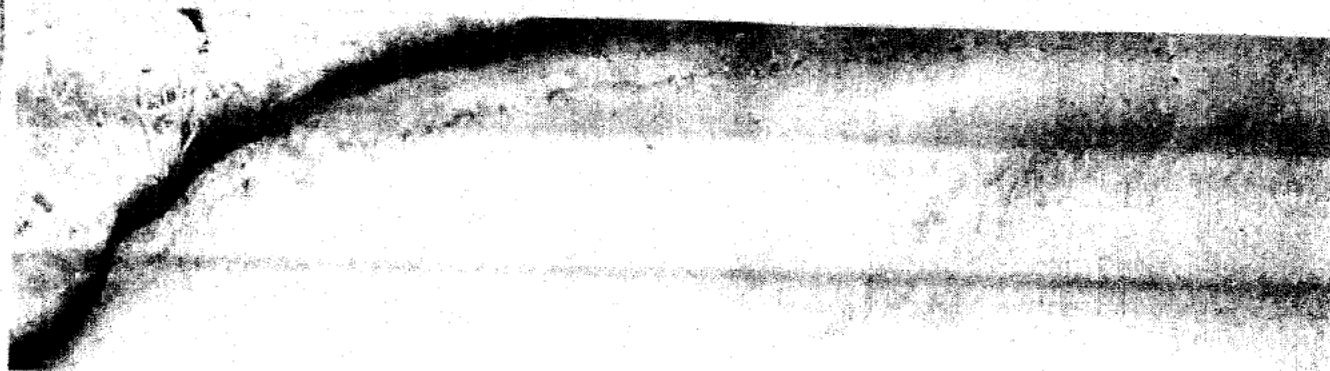


FIGURE 14-2 - Shoreline, Breakers, Whitecaps, and Natural Sea Surface Patterns (1802 R; 2000 ft; 41°00'N; 72°55'W; 1.2 by 3.3 nmi; 0-22 fathoms)



FIGURE 14-3 - Natural Sea Surface Patterns (1810 R; 2000 ft; 41°10'N; 72°25'W; 1.2 by 3.3 nmi; 3-25 fathoms)

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FIGURE 14-4 - Natural Sea Surface Patterns (1812 R; 2000 ft; $41^{\circ}10'N$; $72^{\circ}15'W$; 1.2 by 3.3 nmi; 18-26 fathoms)



FIGURE 14-5 - Natural Sea Surface Patterns (1814 R; 2000 ft; $41^{\circ}10'N$; $72^{\circ}05'W$; 1.2 by 3.3 nmi; 3-54 fathoms)



FIGURE 14-6 - Natural Sea Surface Patterns (1815 R; 2000 ft; $41^{\circ}10'N$; $72^{\circ}00'W$; 1.2 by 3.3 nmi; 12-47 fathoms)



FIGURE 14-7 - Shoreline, Breakers, and Natural Sea Surface Patterns (1821 R; 2000 ft; $41^{\circ}00'N$; $71^{\circ}55'W$; 1.2 by 3.3 nmi; 0-15 fathoms)

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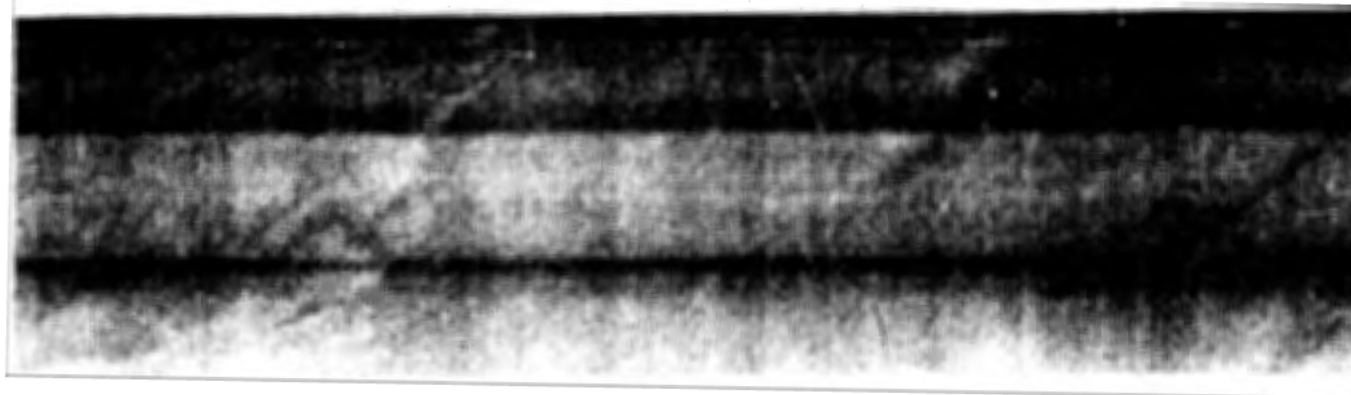


FIGURE 14-8 - Natural Sea Surface Patterns (1825 R; 2000 ft; 40°55'N; 72°05'W; 1.2 by 3.3 nmi; 10-20 fathoms)

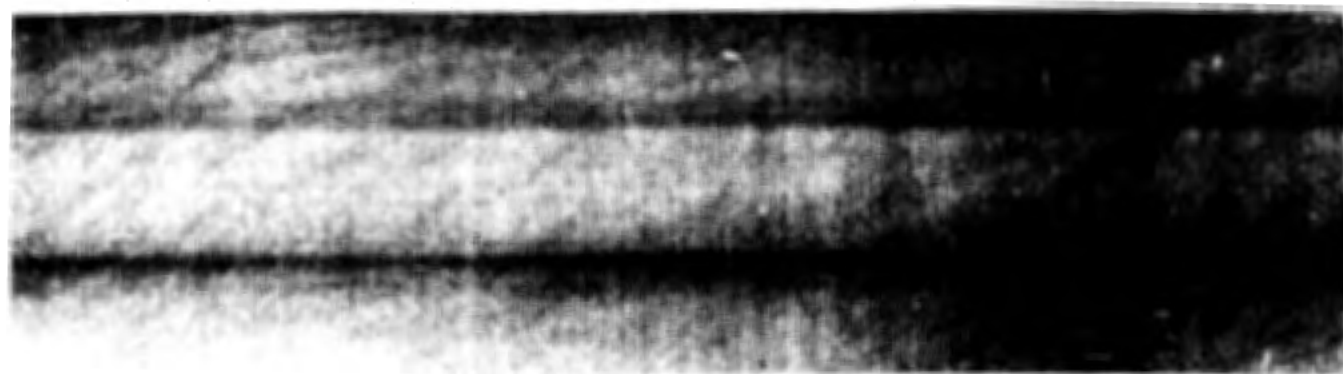


FIGURE 14-9 - Natural Sea Surface Patterns (1827 R; 2000 ft; 40°50'N; 72°10'W; 1.2 by 3.3 nmi; 10-20 fathoms)

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FIGURE 14-10 - Whitecaps and Natural Sea Surface Patterns (1836 R; 2000 ft; 40°45'N; 72°35'W;
2 by 3.3 nmi; 10-20 fathoms)

This series of 5 thermal pictures was recorded by the
AN/AAD-2 installed in NAVAIRDEVCOEN P2V-5F aircraft
BuNo 131403

Date: 18 January 1962

Sunset: 1702 R; Moonrise: 1521 R

Air Temperature (2100 ft): 3°C

Cloud Cover: scattered - bottoms at 10,000 ft, high overcast

Detector: 2.5 by 2.5 mm InSb (Philco)

NOTE: Figure 15-1 was obtained using the circular 6.25 mm² Ge:Hg (Texas Instruments Inc)

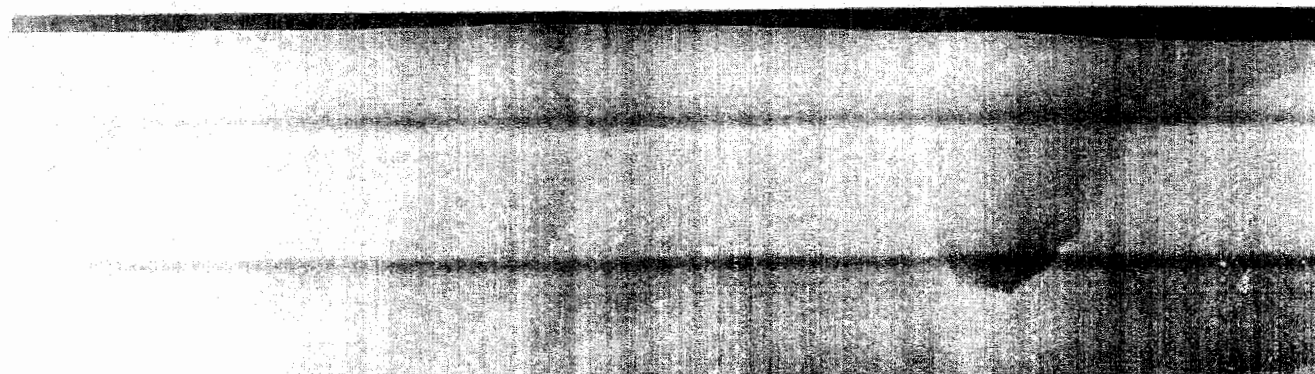
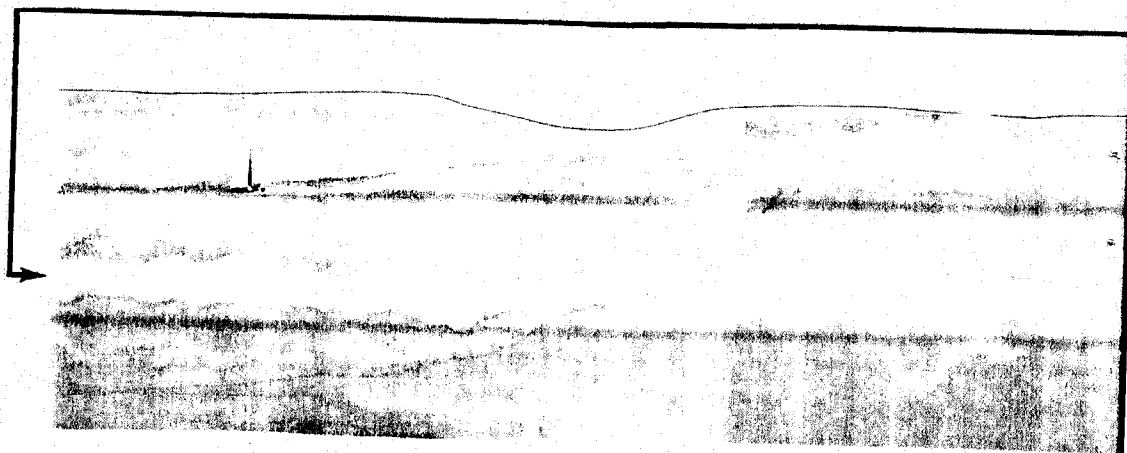
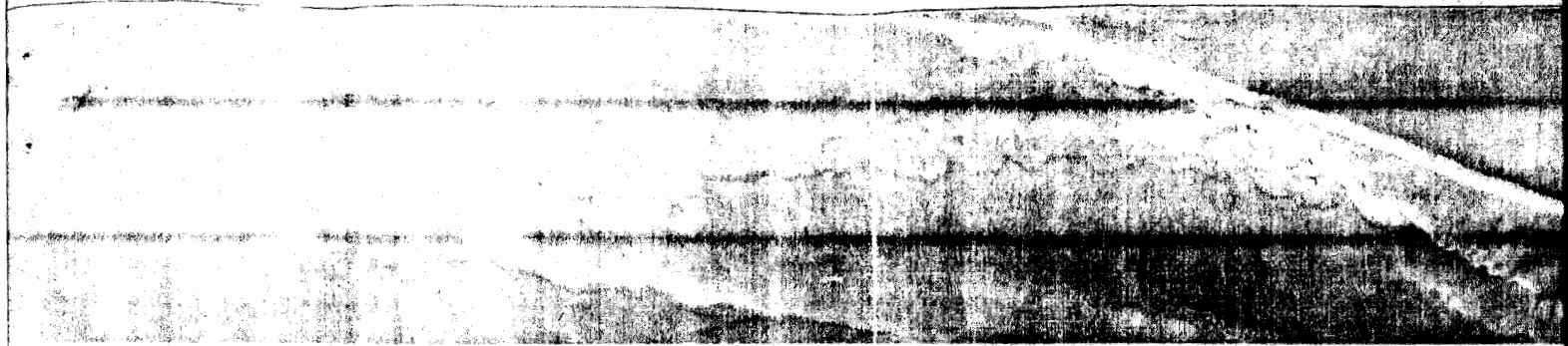
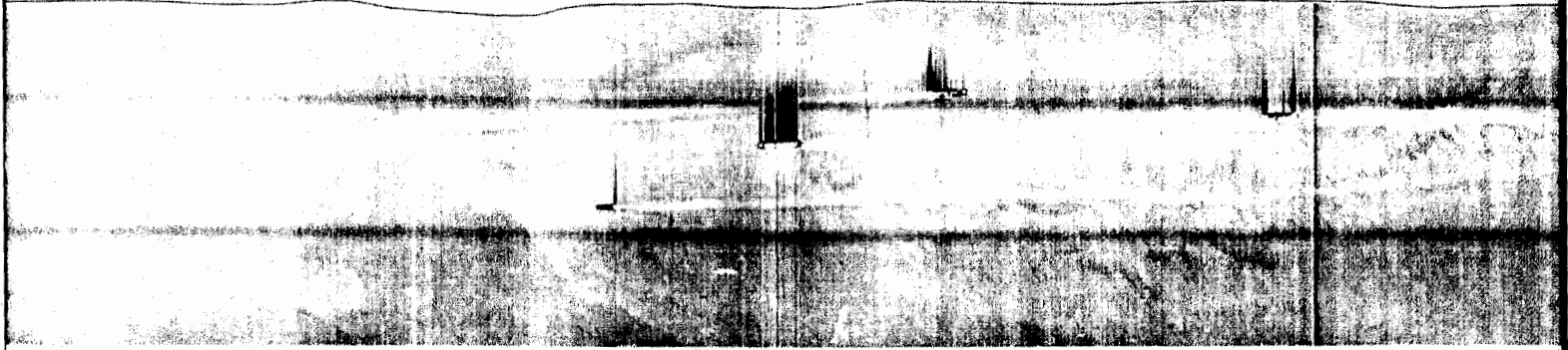


FIGURE 15-1 - Natural Sea Surface Patterns (1858 R; 2100 ft; 39°29'N; 74°16'W; 1.2 by 3.2 nmi;
1-7 fathoms)



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FIGURE 15-2 -
Bay) (1955 R;

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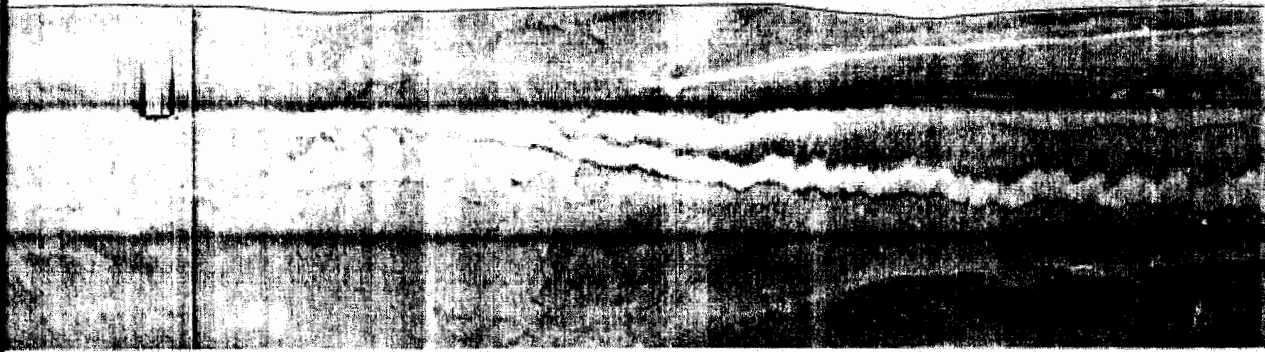


FIGURE 15-2 - Ships, Wakes, and Natural Water Surface Patterns (Delaware Bay) (1955 R; 2100 ft; 38°55'N; 75°05'W; 1.2 by 13 nmi; 5-11 fathoms)

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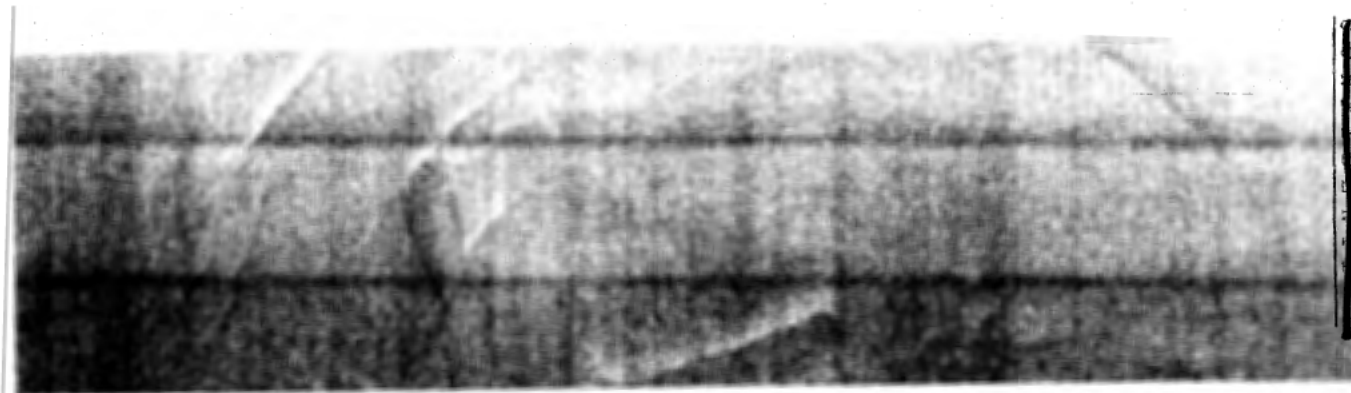


FIGURE 15-3 - Natural Sea Surface Patterns (2006 R; 2100 ft; 39°08'N; 74°40'W; 1.2 by 3.2 nmi; 1-7 fathoms)

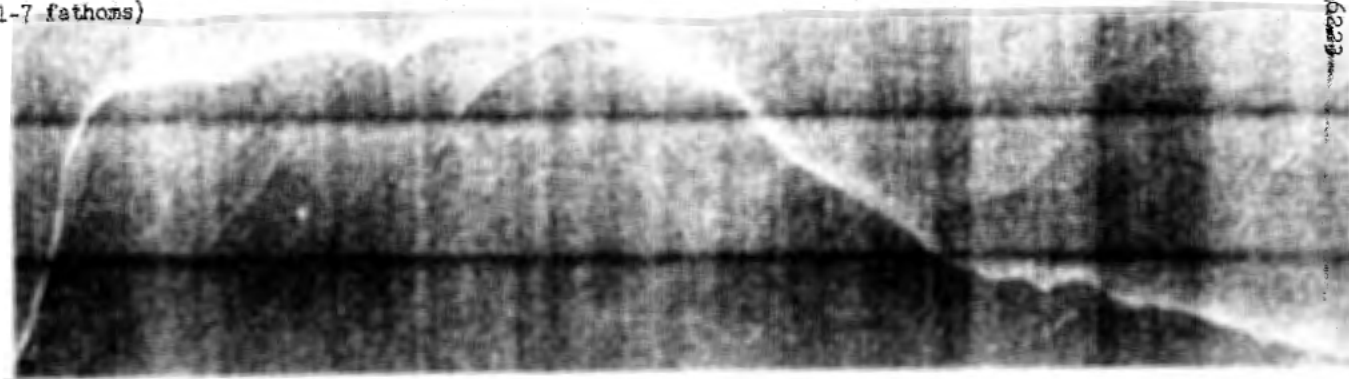


FIGURE 15-4 - Natural Sea Surface Patterns (2010 R; 2100 ft; 39°16'N; 74°32'W; 1.2 by 3.2 nmi; 1-7 fathoms)

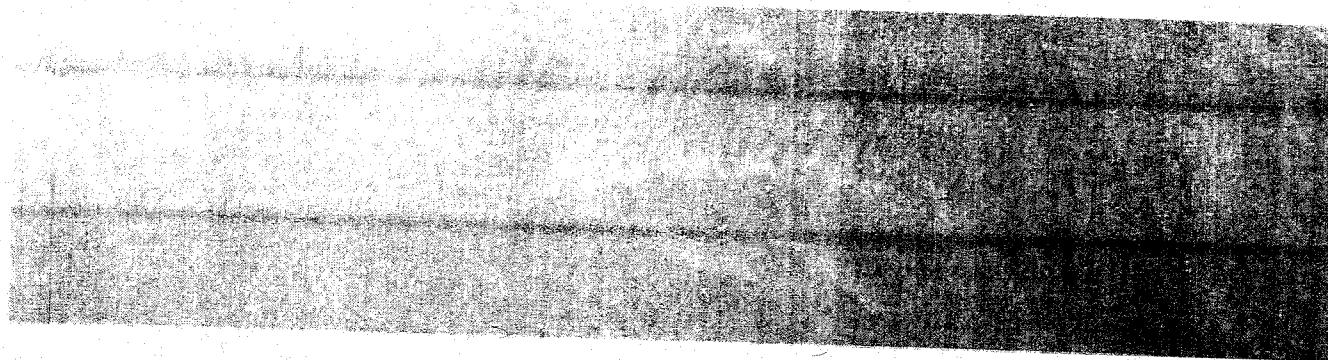


FIGURE 15-5 - Natural Sea Surface Patterns (2017 R; 2100 ft; 39°30'N; 74°16'W; 1.2 by 3.2 nmi;
1-7 fathoms)

This series of 12 thermal pictures was recorded by the
AN/AAD-2 installed in the NAVAL DEVCEN P2V-5P aircraft
BuNo 131403

Date: 15 February 1962

Sunset: 1735 R; Moonrise: 1409 R

Air Temperature (5000 ft): -2° C

Cloud Cover: scattered - bottoms at 2500 ft

Detector: Circular, 6.25 m² Ge:Cu (Raytheon)

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FIGURE 16-1 - Shoreline, Breakers, Whitecaps and Natural Sea Surface Patterns (1512 R: 1000 ft;
33°35'N; 74°10'W; 0.6 by 1.9 mi; 0-10 fathoms)

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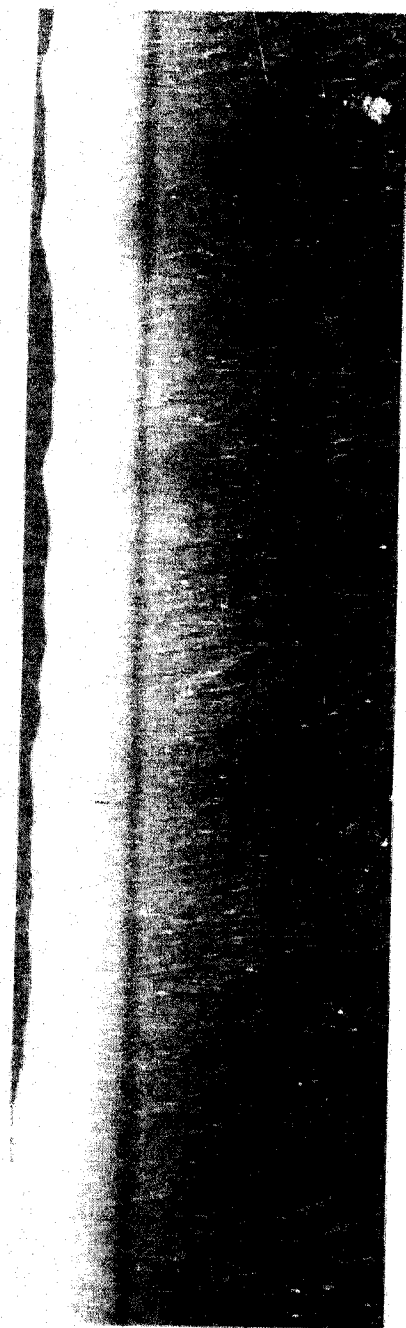


FIGURE 16-2 - Whitecaps and Natural Sea Surface Patterns (1516 R; 1000 ft; 39°26'N; 74°15'W;
0.6 by 1.9 nmi; 1-10 fathoms)

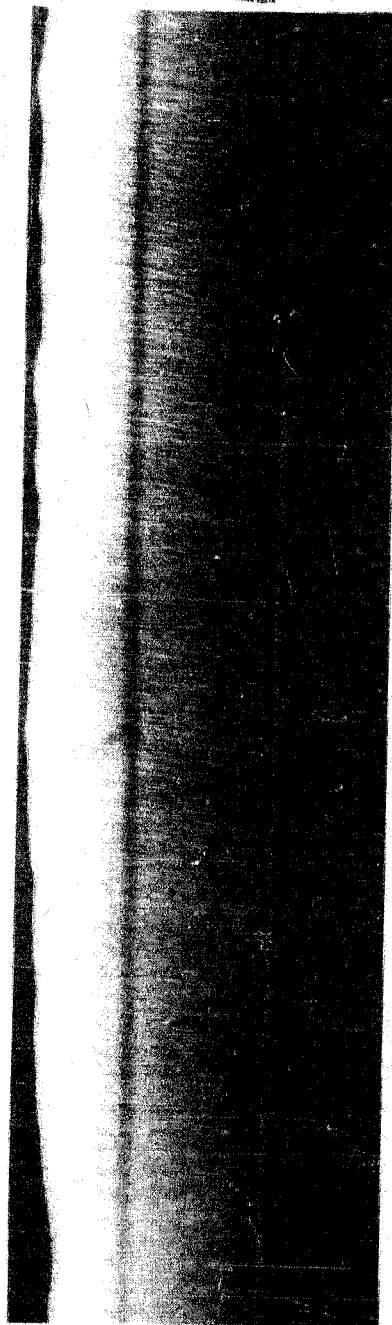


FIGURE 16-3 - Whitecaps and Natural Sea Surface Patterns (1524 R; 1000 ft; 39°06'N; 74°40'W;
0.6 by 1.9 nmi; 1-10 fathoms)

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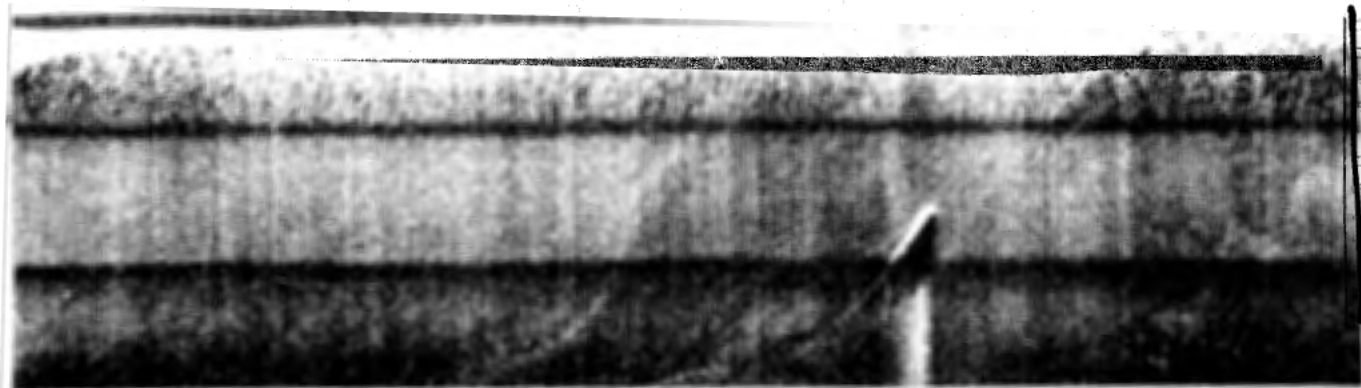


FIGURE 16-4 - Ship, Wake and Natural Water Surface Patterns (Delaware Bay) (1539 R; 1500 ft; 39°02'N; 75°10'W; 0.9 by 3.3 nmi; 1-7 fathoms)



FIGURE 16-5 - Lighthouse, Wake and Natural Water Surface Patterns (Delaware Bay) (1546 R; 1800 ft; 39°11'N; 75°16'W; 1.0 by 2.0 nmi; 1-6 fathoms)

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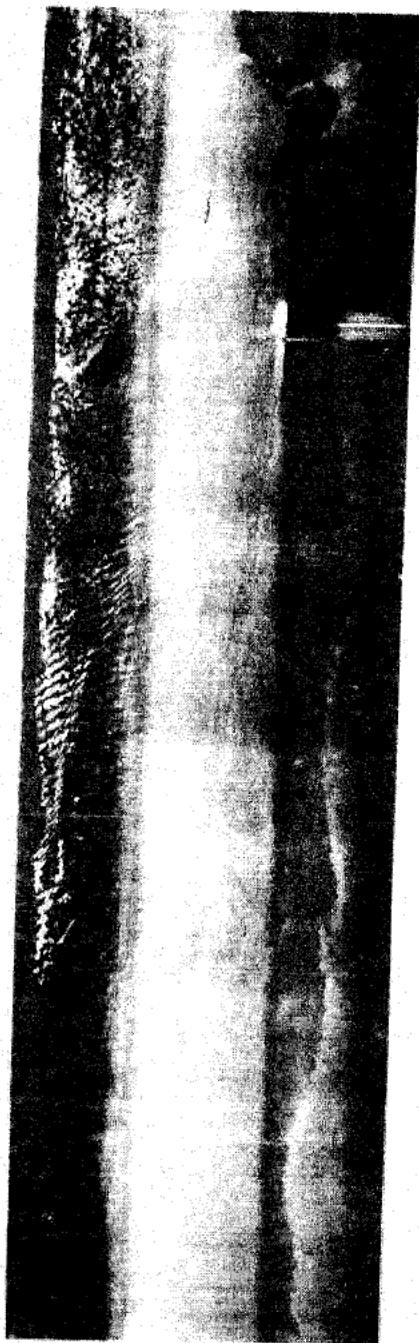


FIGURE 16-6 - Ship, Wake and Natural Water Surface Patterns (Delaware Bay) (1548 R; 1800 ft; 39°20'N; 75°20'W; 1.0 by 3.3 mi; 1-10 fathoms)

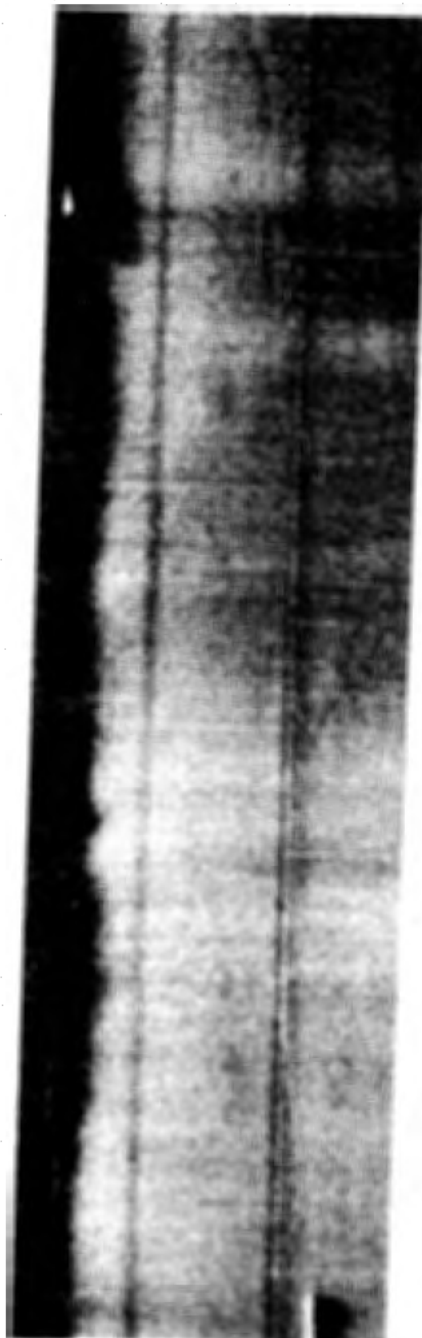


FIGURE 16-7 - Ship, Wake and Natural Water Surface Patterns (Delaware Bay) (1550 R; 1800 ft; 39°25'N; 75°30'W; 1.0 by 3.3 mi; 1-5 fathoms)

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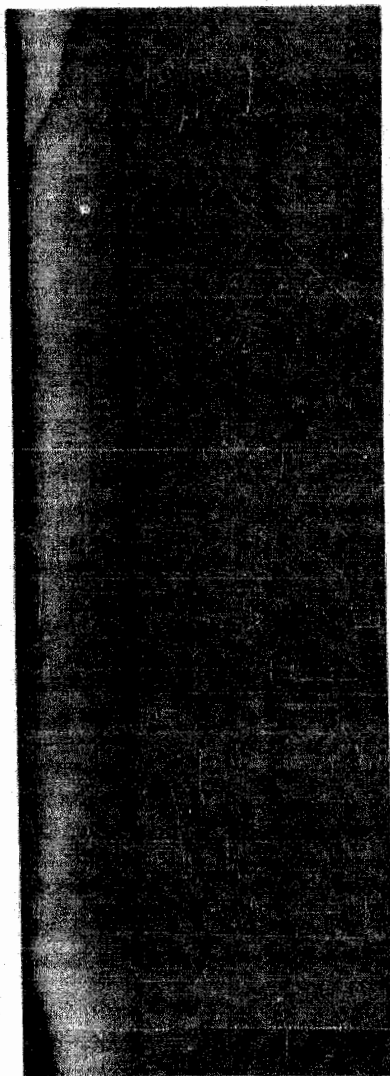


FIGURE 16-8 - Natural Water Surface Patterns (Delaware Bay) (1553 R; 2000 ft; 39°25'N; 75°30'W;
1.2 by 2.5 nmi; 1-5 fathoms)



FIGURE 16-9 - Natural Water Surface Patterns (Delaware Bay) (1607 R; 5000 ft; 39°15'N; 75°20'W;
3.0 by 3.5 nmi; 1-10 fathoms)

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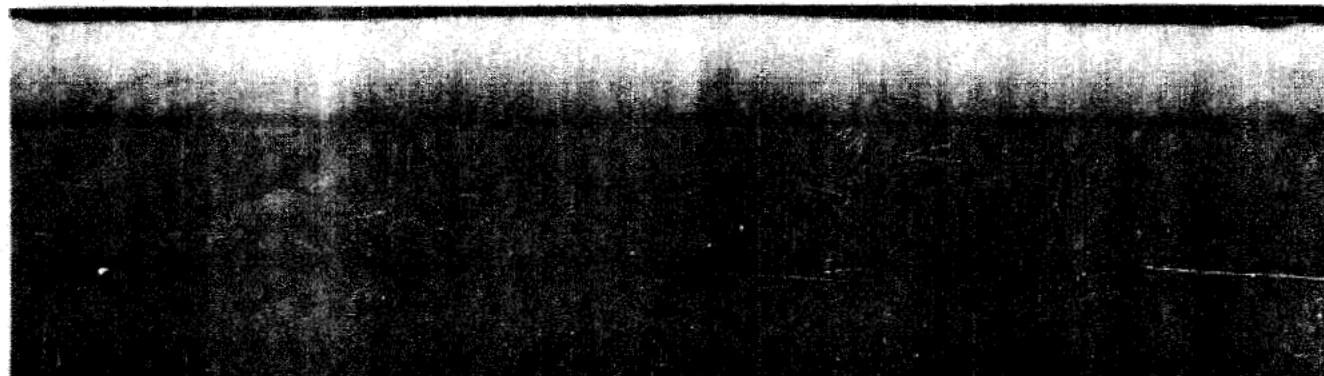


FIGURE 16-10 - Natural Water Surface Patterns (Delaware Bay) (1609 R; 5000 ft; $39^{\circ}10'N$; $75^{\circ}15'W$; 3.0 by 8.0 nmi; 1-8 fathoms)

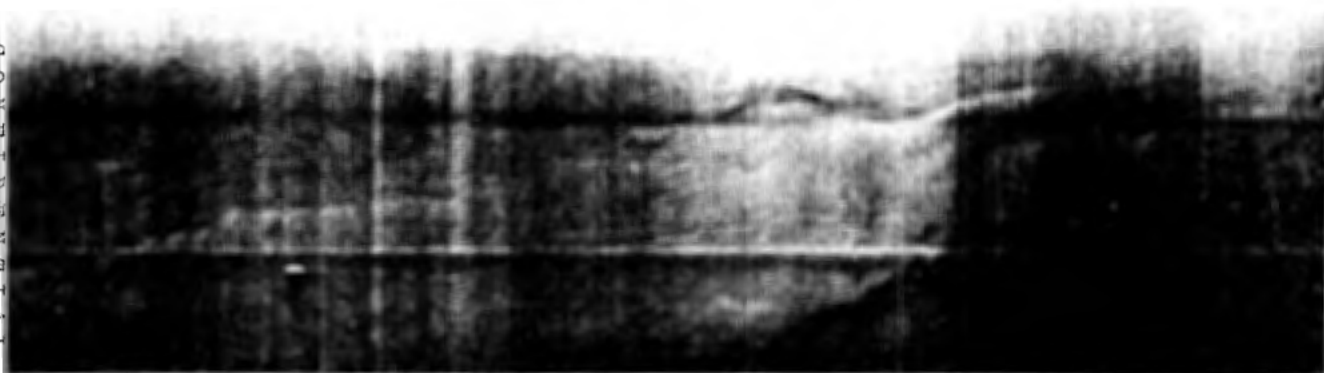


FIGURE 16-11 - Ship, Wake, Channel Buoy and Natural Water Surface Patterns (Delaware Bay) (1714 R; 5000 ft; $39^{\circ}18'N$; $75^{\circ}21'W$; 3.0 by 8.0 nmi; 10-23 fathoms)

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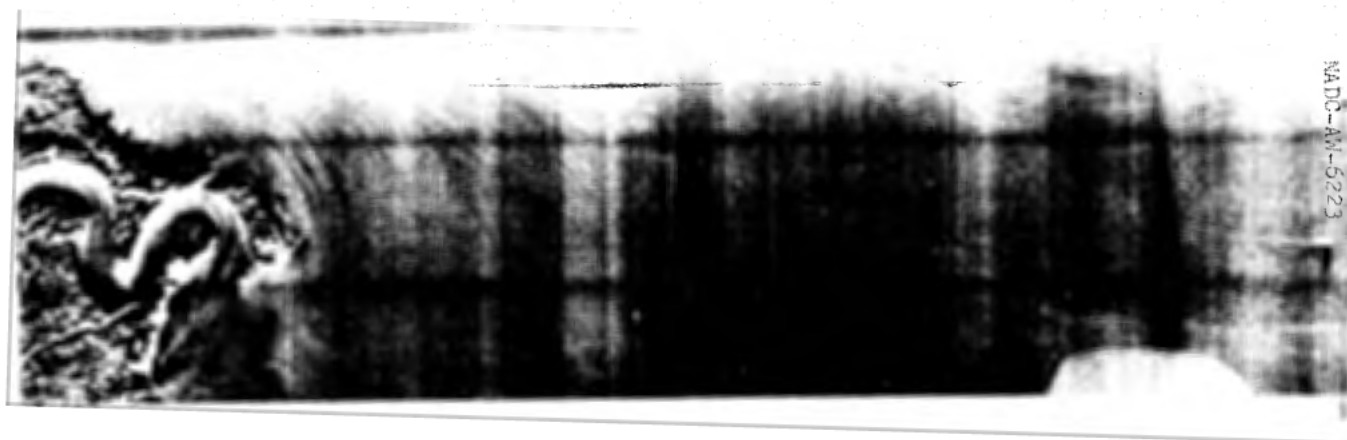


FIGURE 16-12 - Shoreline, Ships, Wakes and Natural Water Surface Patterns (Delaware Bay)
 (1715 R; 5000 ft; 39°21'N; 75°22'W; 3.0 by 8.0 nmi; 0-7 fathoms)

This series of 10 thermal pictures was recorded by the
AN/AAD-2 installed in NAVAIRDEVGEN P2V-5F aircraft

BuNo 131403

Date: 20 February 1962

Sunset: 1741 R; Moonrise: 1847 R

Cloud Cover: scattered

Visibility: 15-20 miles

Detector: Circular, 6.25 mm² Ge:Cu (Raytheon)

NOTE: Figure 17-5 was obtained using the 2.5 by 2.5 mm PbSe (Santa Barbara Research Center)



FIGURE 17-1 - Natural Sea Surface Patterns (1446 R; 2000 ft; 39°30'N; 74°15'W; 1.2 by 1.2 nmi;
1-10 fathoms)



FIGURE 17-2 - Natural Water Surface Patterns (mouth of Delaware Bay) (1510 R; 2000 ft; 38°50'N; 75°05'W; 1.2 by 3.2 nmi; 2-25 fathoms)

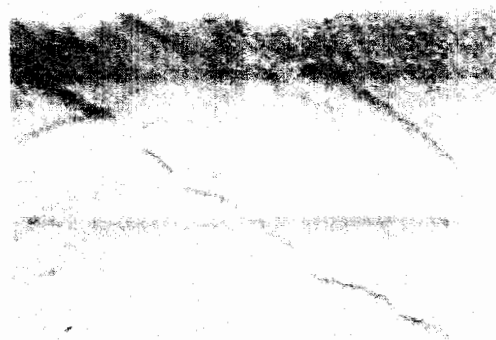


FIGURE 17-3 - Natural Water Surface Patterns (Delaware Bay) (1517 R; 2000 ft; 39°05'N; 75°16'W; 1.2 by 1.1 nmi; 1-10 fathoms)

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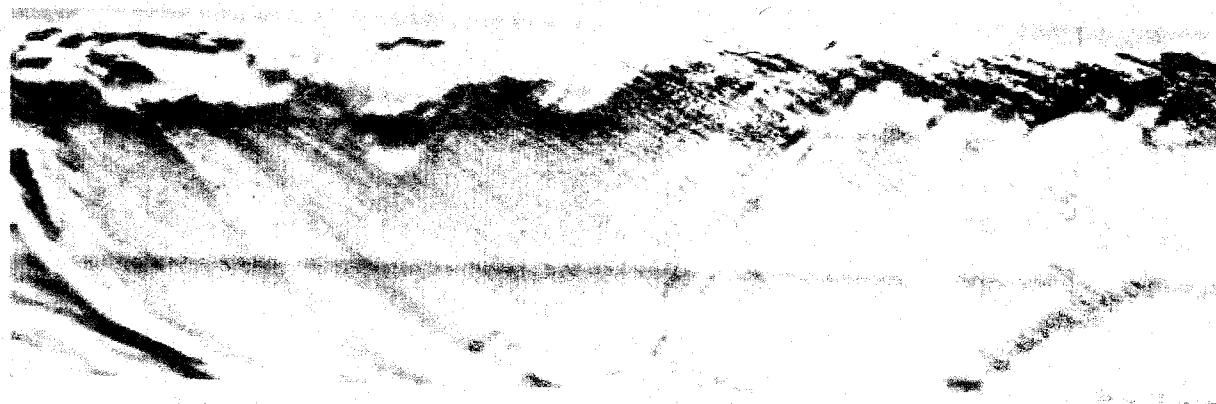


FIGURE 17-4 - Natural Water Surface Patterns (Delaware Bay) (1523 R; 2000 ft; 39°20'N; 75°22'W; 1.2 by 2.6 nmi; 0-3 fathoms)

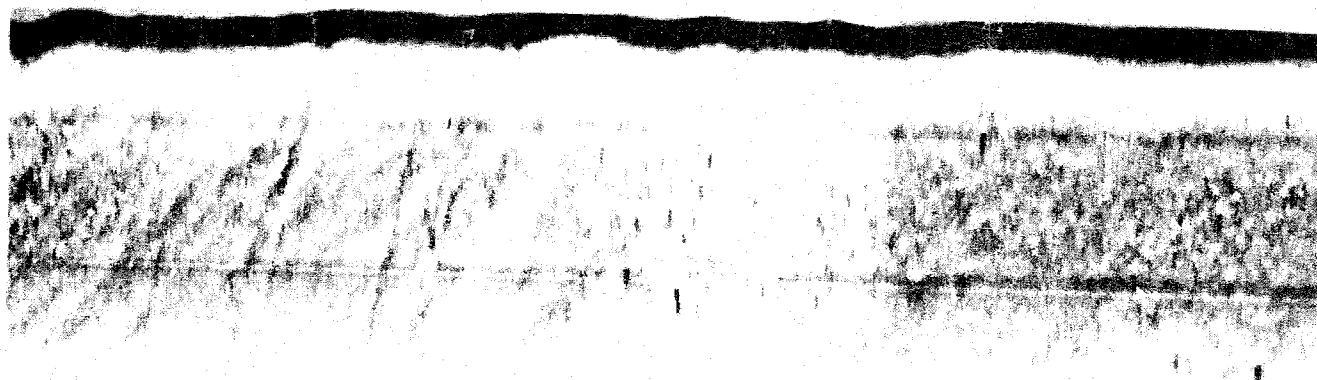


FIGURE 17-5 - Natural Water Surface Patterns (crossing Liston Range of Delaware Bay Main Channel) (1600 R; 2000 ft; 39°15'N; 75°19'W; 1.2 by 2.9 nmi; 1-8 fathoms)

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FIGURE 17-6 - Natural Sea Surface Patterns (1625 R; 1500 ft; 38°54'N; 74°50'W; 0.9 by 2.4 nmi; 1-7 fathoms)



FIGURE 17-7 - Natural Sea Surface Patterns (1628 R; 1500 ft; 39°00'N; 74°45'W; 0.9 by 2.3 nmi; 1-10 fathoms)

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FIGURE 17-8 - Natural Sea Surface Patterns (1636 R; 1500 ft; $39^{\circ}17'N$; $74^{\circ}30'W$; 0.9 by 1.7 nmi; 1-10 fathoms)



FIGURE 17-9 - Natural Sea Surface Patterns (1640 R; 1500 ft; $39^{\circ}27'N$; $74^{\circ}18'W$; 0.9 by 2.2 nmi; 1-10 fathoms)

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FIGURE 17-10 - Natural Sea Surface Patterns (1648 R; 1500 ft; 39°45'N; 74°05'W; 0.9 by 2.3 nmi;
1-10 fathoms)

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This thermal picture was recorded by the AN/AAD-2
installed in the NAVAIRDEVGEN P2V-5F aircraft BuNo 131403
Date: 8 March 1962
Sunset: 1759; Moonset: 2048
Air Temperature (1500 ft): 1°C
Cloud Cover: scattered to broken - bottoms at 2500 ft
Visibility: 10-15 miles, hazy
Detector: 2.5 by 2.5 mm PbSe (Santa Barbara Research Center)

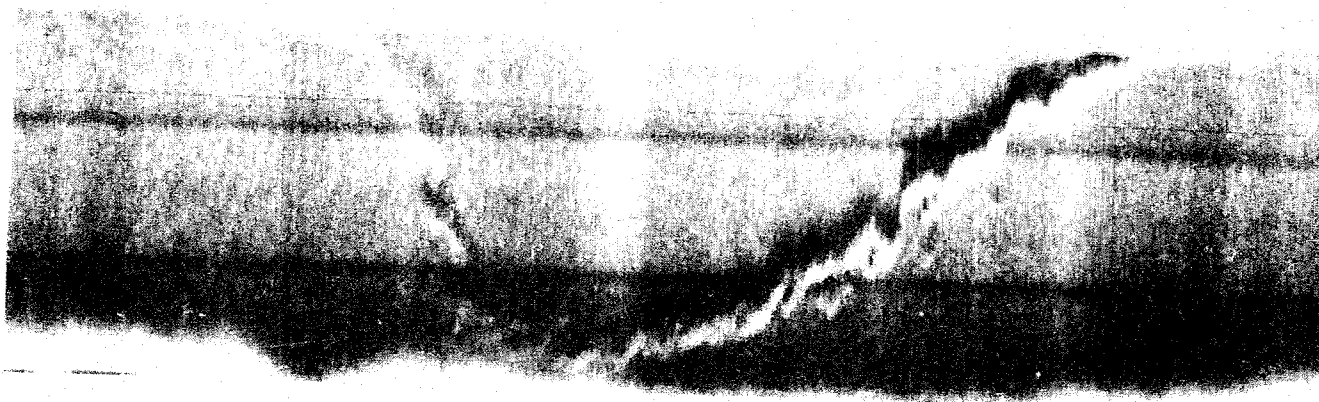


FIGURE 18 - Natural Sea Surface Patterns (1839 R; 1500 ft; 40°10'N; 71°58'W; 0.9 by 4.4 nmi;
34-42 fathoms)

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This series of 2 thermal pictures was recorded by the AN/AAD-2
installed in NAVAIRDEVCOM P2V-5F aircraft BuNo 131403
Date: 14 March 1962
Sunset: 1508 R; Moonrise: 1510 R
Air Temperature (4500 ft): 22°C
Cloud Cover: scattered - bottoms at 2500 ft
Detector: Circular, 6.25 mm² Ge:Ga (Raytheon)

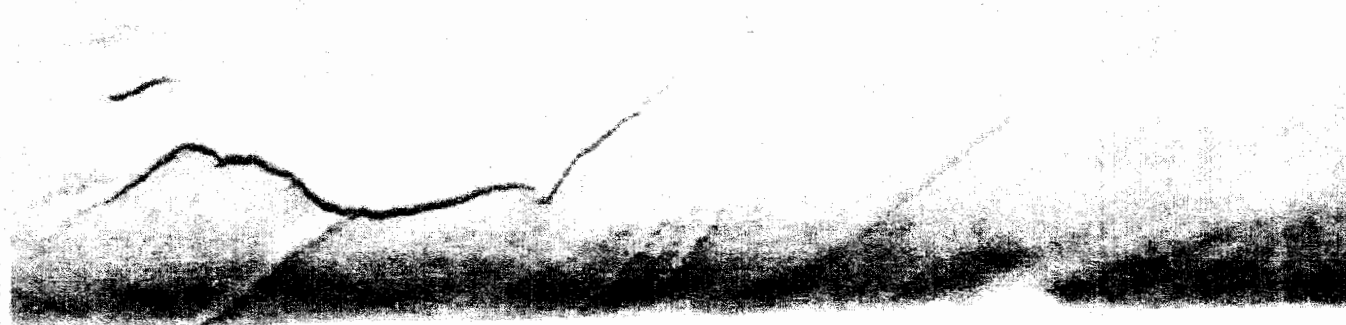


FIGURE 19-1 - Two Ship Wakes and Natural Sea Surface Patterns (1830 R; 4500 ft; 24°32'N;
83°02'W; 2.6 by 6 nmi; 13-22 fathoms)

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FIGURE 19-2 - Natural Sea Surface Patterns (2320 ft; 2500 ft; 24°34'N; 81°50'W; 1.5 by 3.8 mi;
0-6 fathoms)

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This series of 9 thermal pictures was recorded by the AN/AAD-2 installed
in NAVAIRDEVCON P2V-5F aircraft BuNo 131403
Date: 15 March 1962
Sunset: 1809 R; Moonrise: 1400 R
Air Temperature (surface): 25°C
Cloud Cover: scattered
Detector: Circular, 6.25 mm² Ge:Ga (Raytheon)



FIGURE 20-1 - Natural Sea Surface Patterns (1830 R; 4500 ft; 24°40'N; 82°45'W; 2.6 by 6.6 nmi;
0-15 fathoms)



FIGURE 20-2 - Loggerhead Key and Natural Sea Surface Patterns (1833 R; 4500 ft; $24^{\circ}38'N$; $82^{\circ}56'W$; 2.6 by 6.6 nmi; 0-11 fathoms)



FIGURE 20-3 - Ship Wakes and Natural Sea Surface Patterns (1836 R; 4500 ft; $24^{\circ}32'N$; $83^{\circ}02'W$; 2.6 by 6.6 nmi; 13-21 fathoms)



FIGURE 20-4 - Natural Sea Surface Patterns (2155 R; 1600 ft; $24^{\circ}00'N$; $83^{\circ}00'W$; 0.9 by 1.0 nmi; 500-600 fathoms)



FIGURE 20-5 - Ship Wake and Natural Sea Surface Patterns (2202 R; 1900 ft; $24^{\circ}10'N$; $82^{\circ}10'W$; 1.1 by 3.1 nmi; 300-400 fathoms)

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FIGURE 20-6 - Ship Wake and Natural Sea Surface Patterns (2203 R; 1930 ft; 24°11'N; 82°38'W; 1.1 by 3.2 nmi; 300-400 fathoms)



FIGURE 20-7 - Natural Sea Surface Patterns (2206 R; 1900 ft; 24°15'N; 82°29'W; 1.2 by 3.0 nmi; 200-300 fathoms)

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FIGURE 20-8 - Natural Sea Surface Patterns (2207 R; 1900 ft; 24°15'N; 82°27'W; 1.1 by 3.2 nmi; 200-300 fathoms)



FIGURE 20-9 - Boca Grande Key, Woman Key, and Natural Sea Surface Patterns (2222 R; 1900 ft; 24°32'N; 82°00'W; 1.1 by 3.2 nmi; 0-4 fathoms)

This series of 12 thermal pictures was recorded by the AN/AAD-2
installed in NAVAIRDEVCON P2V-5F aircraft BuNo 131403
Date: 28 March 1962
Sunset: 1820 R; Moonrise: 0124 R (29 Mar)
Air Temperature (2000 ft): 11°C
Cloud Cover: none
Visibility: 15-20 miles
Detector: Circular, 6.25 mm² Ge:Cu (Raytheon)

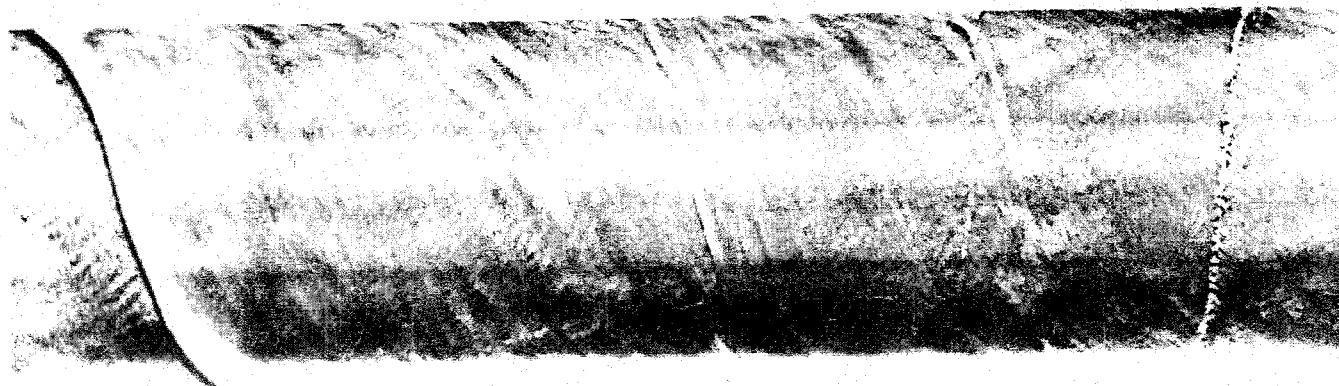


FIGURE 21-1 - Possible Ship Wakes and Natural Sea Surface Patterns (1921 R; 2500 ft; 40°19'N;
73°50'W; 1.5 by 4.0 nmi; 10-30 fathoms)



FIGURE 21-2 - Natural Sea Surface Patterns (2116 R; 2700 ft; 40°29'N; 71°58'W; 1.6 by 4.0 nmi; 35 fathoms)

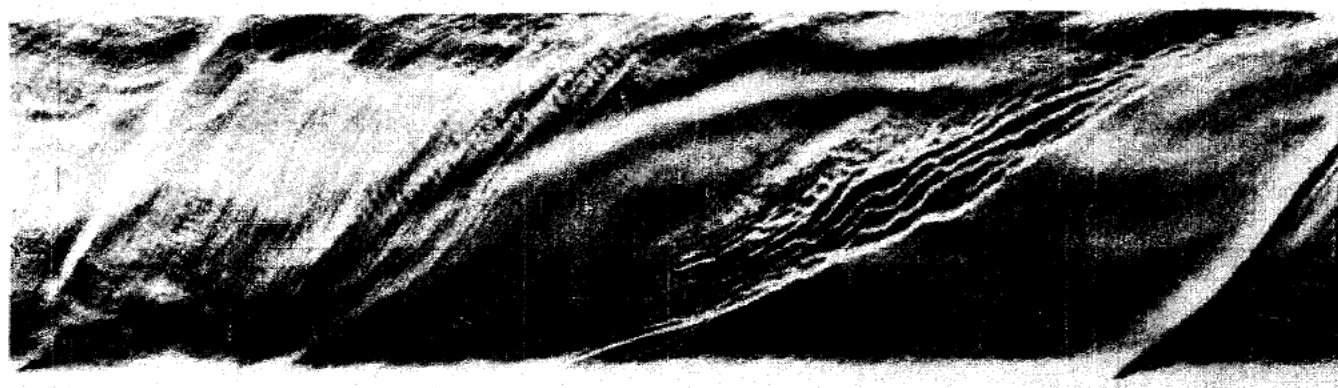


FIGURE 21-3 - Natural Sea Surface Patterns (2128 R; 2600 ft; 40°28'N; 71°58'W; 1.5 by 4.0 nmi; 35 fathoms)

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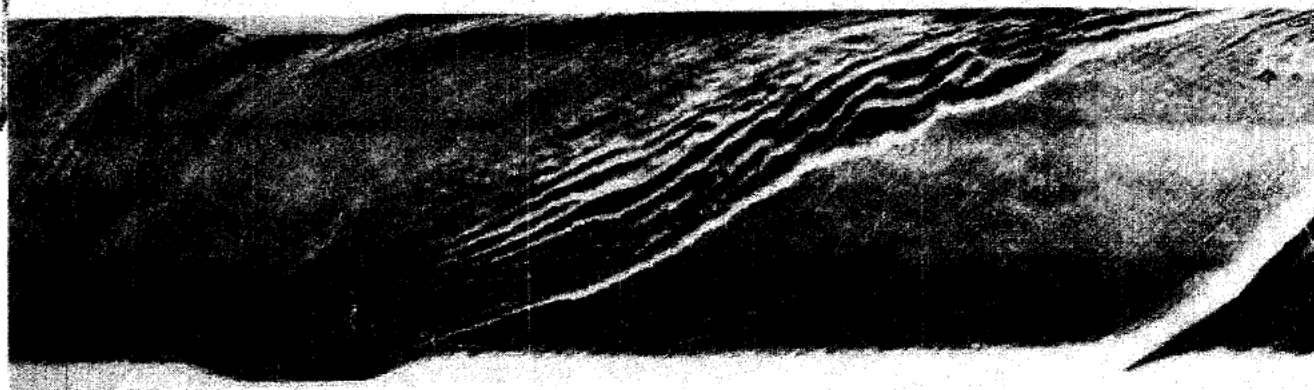


FIGURE 21-4 - Natural Sea Surface Patterns (2207 R; 1800 ft; $40^{\circ}28'N$; $71^{\circ}58'W$; 1.1 by 2.8 nmi; 35 fathoms)



FIGURE 21-5 - Natural Sea Surface Patterns (2253 R; 1600 ft; $40^{\circ}22'N$; $71^{\circ}57'W$; 1.0 by 2.8 nmi; 35 fathoms)

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FIGURE 21-6 - Natural Sea Surface Patterns (2357 ft; 40°28'N; 72°00'W; 1.6 by 4.0 nmi; 35 fathoms)



FIGURE 21-7 - Natural Sea Surface Patterns (2402 ft; 40°26'N; 73°46'W; 1.6 by 4.0 nmi; 15-20 fathoms)

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FIGURE 21-8 - Natural Sea Surface Patterns (2114 R; 2800 ft; 1.6 by 4.5 nmi)



FIGURE 21-9 - Natural Sea Surface Patterns (2112 R; 2800 ft; 1.6 by 4.2 nmi)

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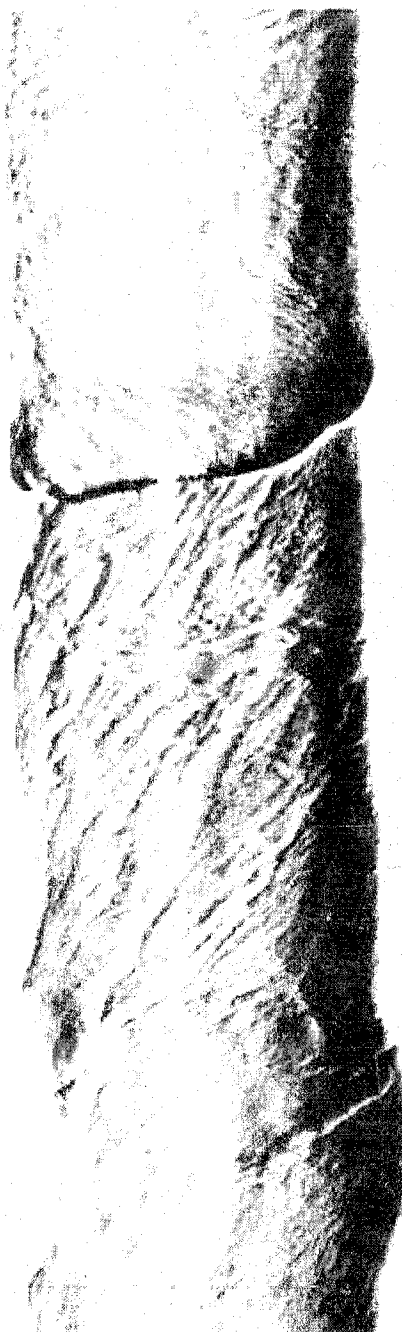


FIGURE 21-10 - Natural Sea Surface Patterns (2422 ft; 2800 ft; 40°13'N; 73°45'W; 1.6 by 4.5 nmi; 15-20 fathoms)



FIGURE 21-11 - Natural Sea Surface Patterns (2423 ft; 2800 ft; 40°13'N; 73°54'W; 1.6 by 4.4 nmi; 10-15 fathoms)

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FIGURE 21-12 - Shoreline and Natural Sea Surface Patterns (2425 B; 2800 ft; 40°13'N; 71°00'W;
1.6 by 4.4 umi; 0-10 fathoms)

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1	Schematic of AN/AAD-2 Operation
2	(b)(1) per E.O. 13526 Section 3.3(b)(4)
3	Shoal Water in the Vicinity of Waretown, New Jersey (2200 R; 5000 ft; 39°47'N; 74°10'W; 4 by 4.5 nmi; 0-1.5 fathoms) (Reconofax Camera)
4	Surfaced Submarine, Wake, and Natural Sea Surface Patterns (1900 R; 1300 ft; 39°52'N; 71°29'W; 0.8 by 1.8 nmi; 193-465 fathoms) (AN/AAD-2)
5	Shoreline and Natural Sea Surface Patterns (1730 R; 1600 ft; 40°17'N; 74°02'W; 0.9 by 2.6 nmi; 0-8 fathoms) (AN/AAD-2)
6	Shoreline and Natural Sea Surface Patterns (1730 R; 1800 ft; 40°17'N; 74°02'W; 0.5 by 2.6 nmi; 0-8 fathoms) (AN/AAR-13(XH-1))
7	Overflow of Water from Takanassee Lake Reservoir (2306 R; 2200 ft; 40°17'N; 74°00'W; 1.3 by 2.3 nmi; 0-8 fathoms) (AN/AAD-2)
8	Tributaries of Shrewsbury River, Shoreline and Natural Water Surface Patterns (1754 R; 2000 ft; 40°19'N; 74°00'W; 1.2 by 3.3 nmi; 0-4 fathoms) (AN/AAD-2)
9	Natural Sea Surface Patterns (2216 R; 3500 ft; 40°15'N; 73°00'W; 2.0 by 6.3 nmi; 20-25 fathoms) (AN/AAD-2)
10-1	Natural Sea Surface Patterns (1950 R; 2500 ft; 40°00'N; 72°00'W; 1.5 by 5.5 nmi; 40-75 fathoms) (AN/AAD-2)
10-2	Blimp and Natural Sea Surface Patterns (2053R; 2500 ft; 40°00'N; 72°00'W; 1.5 by 3.5 nmi; 40-75 fathoms) (AN/AAD-2)
10-3	Blimp and Natural Sea Surface Patterns (2107 R; 2500 ft; 40°00'N; 72°00'W; 1.5 by 3.5 nmi; 40-75 fathoms) (AN/AAD-2)

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INDEX OF FIGURES (Continued)

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